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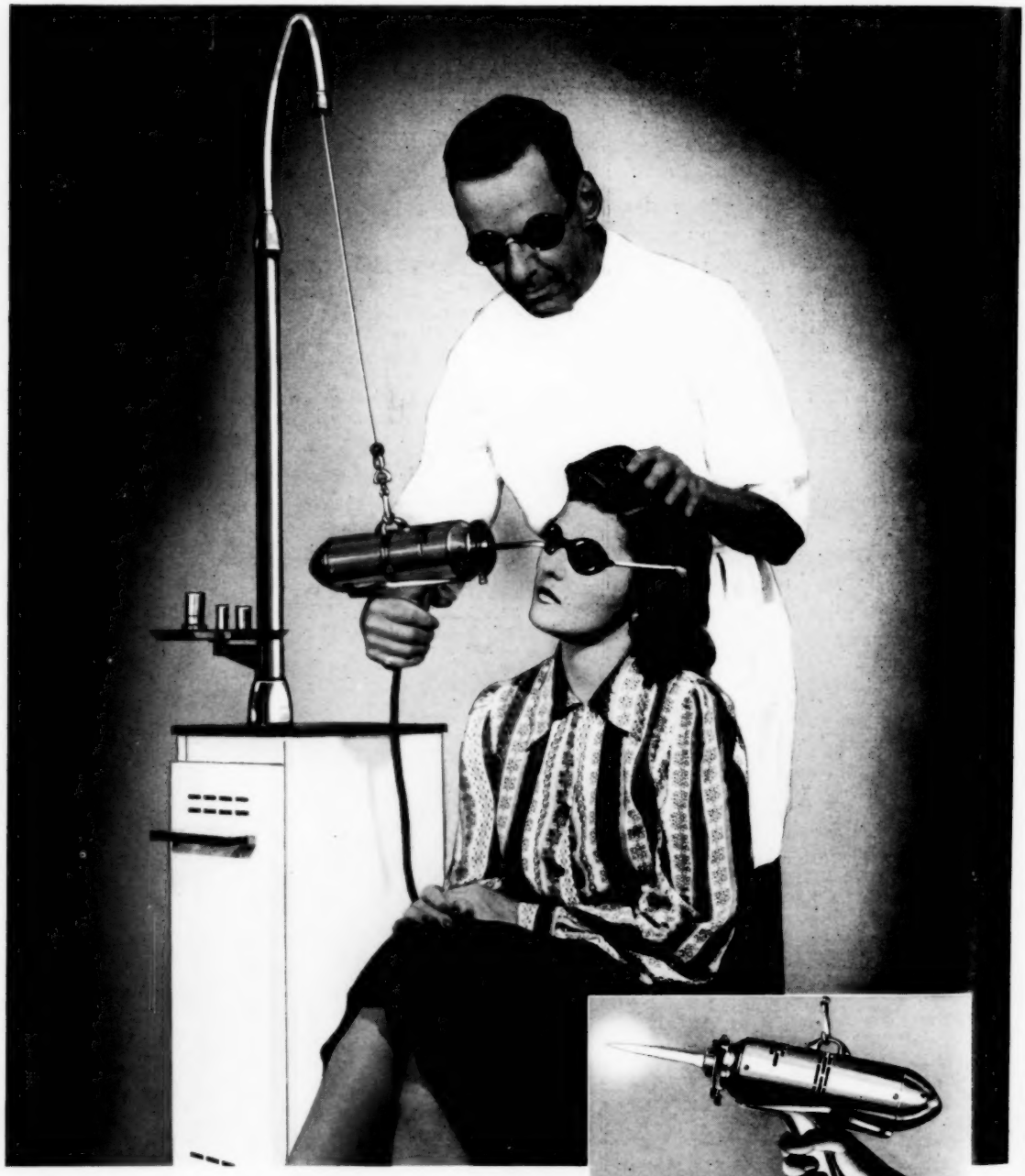

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PHYSICAL THERAPY COMPARED WITH OTHER MEASURES IN ARTHRITIS *

RUSSELL L. CECIL, M.D.

NEW YORK

We are all agreed that there is no specific therapy for chronic arthritis. Many claims have been made for various agents, but none of these has proved to be as wonderful as was claimed for it.

The next point to emphasize is that there are several important and prevalent forms of arthritis and that the treatment for the different types varies considerably. This is true not only of medicinal, but also of physical therapy. However, there are several fundamental principles in the management of arthritis which should be discussed before we take up the various forms in detail.

General Measures

Rest is helpful in all forms of arthritis, and many of the milder forms will make a complete recovery on rest alone. By rest we mean not only physical rest in bed, but immobilization of the joints for a certain part of the time.

Psychotherapy is a fundamental principle and covers mental and emotional rest, that is, freedom from worries, fears or anxieties. Modern students have clearly shown that the mind and the emotions play a significant role in the prognosis of arthritis.

Nutrition must be considered in most cases of arthritis. Some need a high calory diet, some demand a low calory diet, and a great many are helped by a high vitamin intake.

Allied to nutrition is attention to the bowels. Constipation and faulty digestion must be corrected. Some physicians advise colonic irrigations, but these are rarely necessary in my experience.

Vaccines and *foreign proteins* are useful in many types, but this form of therapy is not so popular as it was a few years ago.

Fever therapy may be applied either with typhoid vaccine intravenously or with the hot box. I had rather promising results a few years ago when I treated fifteen or more cases of chronic infectious arthritis with malarial therapy.

Certain medicines have achieved an important place in the pharmacal treatment of arthritis. The most popular drugs are the salicylates, which are given chiefly for the relief of pain; iron in various forms for the anemia which frequently accompanies arthritis; and gold salts which have become very popular in the last few years, particularly in England, France and Germany. Sulfanilamide has proved to be of great value in gonococcal arthritis. Great claims have been made for sulphur, but the recent careful studies by Freiberg at the University of Michigan throw considerable doubt on its efficacy in this disease.

Transfusions have become very popular in the treatment of infectious arthritis because it is in this type that severe anemia is so often encountered.

Finally, there are the orthopedic features of treatment, which are very important, particularly in the prevention of deformities and in the surgical approach to various joint conditions.

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* Read at Eighteenth Annual Session of the American Congress of Physical Therapy, New York City, September 5, 1939.

Physical Therapy

Physical therapy certainly must be rated as one of the most important measures in arthritis. Much of it consists of the application of heat in its various forms. The effects of heat are numerous, but most important perhaps are active hyperemia, mobilization of immune bodies in the infectious forms of arthritis, and sedation.

Ultraviolet radiation we value chiefly for its tonic features. As yet we have no complete understanding of just how ultraviolet light works, but it certainly does a good deal more than merely tan the skin and mobilize the vitamins.

Infra-red light is of value for its hyperemic influence and often seems to achieve results which are not obtained with ordinary reflected light.

Warm baths are helpful in all forms of arthritis. We like particularly to use the warm pool at the New York Hospital for convalescent patients, where the bath serves three purposes: it strengthens the muscles, eliminates stiffness, and acts as a general sedative and appetizer.

With respect to the electrical agents, physicians are partial to short wave diathermy, but I must confess that for the treatment of rheumatoid arthritis, this therapy has been disappointing. For hypertrophic arthritis and bursitis, conventional and short wave diathermy are very helpful.

Pemberton has written much about massage in arthritis, and by carefully planned experimental studies has shown the biologic basis for massage therapy. This is a form of therapeutics in which the personality and skill of the operator play a very important part.

Closely related to massage are active and passive exercises which play an essential rôle in the treatment of spondylitis and the infectious forms of chronic arthritis. I am particularly partial to postural exercises in the treatment of rheumatoid arthritis. I learned the value of this form of therapy from the Boston school where it has been used with enthusiasm for many years.

Physical Therapy in Various Forms of Arthritis

Gonococcal Arthritis. — For this type the physician must make his choice between sulfapyridine and fever therapy, preferably in the form of short wave. Personally I prefer to use both measures, and by using both it is not necessary to give the patient so much sulfapyridine on the one hand, nor quite such a high degree of fever on the other. This combination brings about a spectacular recovery in most cases of gonococcal arthritis if the infection is not of long standing. In the chronic forms, fever and chemotherapy may have to be supplemented by other forms of physical therapy, such as corrective exercises, orthopedic surgery, and the like.

In *chronic infectious arthritis,* usually spoken of as rheumatoid arthritis, we must distinguish between the active febrile type and the chronic sluggish form. In the former we hospitalize the patient and employ rest, transfusions and fever therapy. As the symptoms improve, gold therapy and possibly vaccines are administered. In the chronic classic rheumatoid type, the patient usually comes to the office or clinic for treatment. We advise rest at home, a high vitamin diet and gold therapy, usually myochrysin, once a week intramuscularly.

At the present time there is a tendency to immobilize some of the joints with splints, especially those cases in which there is a tendency to contraction deformity. Twice a day the splints are removed and active and passive exercises are instituted. This may be supplemented by massage and ultraviolet radiation. We are in favor of treating affected hands with paraffin baths, as they seem to give the patient considerable relief.

In *osteoarthritis* we depend chiefly on physical therapy to relieve the patient. It is important, however, if the patient is overweight, to give a reducing diet.

Diathermy or short wave may be combined with regulation of the bowels and the proper orthopedic measures.

Spondylitis in all its forms is an orthopedic problem, though the medical aspects of the patient should always receive proper attention. Orthopedic measures are supplemented by diathermy, hydrotherapy and infra-red radiation.

Bursitis, if seen early, usually responds kindly to short wave therapy. Indeed it seems to me about the only treatment worth employing, unless we include x-ray therapy which is effective in some cases.

Gout is a disease of metabolism, but in spite of this fact, physical therapy plays an important part in its management. This statement is borne out by the fact that so many gouty patients obtain relief from spa treatment. At the spas they get not only rest and copious water drinking, but hydrotherapy in its best form. I was delighted last winter with the results obtained by hydrotherapy in a persistent case of gout which I had under observation at the New York Hospital. Hot baths seem to achieve more than the most intensive dieting and prohibition.

Summary

Physical therapy is one of the most important measures available to the physician in the management of chronic arthritis. In view of the highly intricate nature of much of the treatment, it should not be undertaken by the general practitioner in his office if he is located in a community where special facilities are available. A good many years' experience have taught me the important lesson that if the best results are to be obtained, treatment must be supervised by a master of the subject, who has devoted years of his life to the application of these various implements. It is a pity that so many amateurs have invaded the field. Every effort should be made to curtail their activities and to permit only those well qualified to practice this specialty. Though I treat a great many patients with arthritis, I have never had any physical therapy equipment in my office, having always felt that in all fairness it should be used by a specialist. By following this rule, I have rarely been disappointed in the results obtained in my patients.

33 East 61st Street.

Discussion

Dr. Frank H. Krusen (Rochester, Minnesota): Dr. Cecil has rightly pointed out the importance of the correlation of physical measures with other therapeutic measures in the management of all phases of arthritis and of the need for establishment of a diagnosis.

Dr. Ralph Pemberton, and Dr. Robert Osgood, have said they rely chiefly on the use of physical measures in the management of arthritis and that failure to employ them in arthritis would be an incongruity which would be obvious even to the layman.

Dr. W. S. C. Copeman, Honorary Secretary of the British Rheumatism Commission, has said that he relied chiefly on physical medicine for the management of his patients with arthritis, and that one of the great advances in the last decade has been the recognition by physicians of the fact that disease may be influenced as much from without, by means of physical measures, as from within by means of medicinal measures.

Dr. Philip S. Hench at the Mayo Clinic has stated that he relies chiefly on physical measures in the management of arthritis.

Nevertheless, we must remember that to use these alone would be as criminal as it would be simply to give an arthritic patient some aspirin and tell him that was the only treatment necessary.

The combination of all of these measures is the most important thing in the management of arthritic patients whom we seek to aid.

Dr. John D. Currence (New York): I think that Dr. Cecil's reference to the fundamental principles in the treatment of arthritis applies right through the field of physical therapy. As far as this discipline is concerned, there is a certain air of mysticism about the subject because of the multiplicity of types of apparatus used. This mysticism really is quite unnecessary, because, after all, physical therapy in arthritis as in most other conditions, evolves down to simple fundamental principles. These principles amount to the application of thermal measures, either heat or cold, exercise — whether it be passive or active, in the air or under water — and to massage, whether it be massage for a mechanical effect or massage for a reflex effect, or administered by mechanical devices.

When it comes to the application of heat, there is a possibility of many different ways to attain what one may desire to accomplish, and probably the best method is the one which can be prescribed to accomplish a definite physiologic purpose, and it may be that this may be accomplished by various means. In other words, if we observe the work of various men treating arthritis by physical measures, one may accomplish a very comparable purpose with various agents.

I think that primarily in physical therapy the classifications in arthritis are probably the most confusing factors we have to deal with. In the application of physical agents, the classifications as hypertrophic or atrophic are worthy of definite consideration because they are the classifications on a pathological basis for which certain measures are either indicated or contraindicated.

But the chief consideration is whether the condition is infectious or not; and if it is, is it actively, acutely so? Is it a chronic, low-grade infection, or is it a latent or quiescent type of infection? The main problem is to avoid reactions by excessive stimulation, either local or general. There are undoubtedly times when one might hope to accomplish a thermal reaction sufficient to kill organisms. However, this is rarely the purpose in physical therapy.

There are many conditions, particularly of the more acute type, that will respond to reactions of sufficient thermal stimulation and produce actually a crisis in the infection and its termination.

In the chronic low grade infections, particularly in what we ordinarily term "rheumatoid" arthritis, I am heartily in accord with Dr. Cecil that in general most of the physical measures actually are contraindicated. Where we accomplish our greatest benefits is undoubtedly in the cases where rehabilitation from damage already done by infection is desired, and here physical therapy rather ceases to be the adjunct, and medicinal therapy becomes the adjunct and physical therapy the chief factor in rehabilitation.

In the hypertrophic or the osteoarthritic type, undoubtedly physical therapy does play the most important role. In senile types of arthritis it is essential that topical heat measures be used with caution so as not to debilitate the individual or run the hazard of any accident to the vascular system by virtue of over-enthusiasm in the treatment.

In other than senile types such as menopausal, osteo-arthritic or post-traumatic arthritis, local treatments are of undisputed value, and probably our greatest single measure of benefit, certainly far more than can be accomplished by medical measures.

Dr. R. L. Bennett, Jr. (Rochester, Minn.): It has been a great pleasure to hear both Dr. Cecil's paper and Dr. Currence's excellent discussion, and they leave me very little to say, although there are a few points which I believe deserve further emphasis.

When I read the title of the paper in the program, I was surprised to find that a comparison was to be made between physical therapy and the other methods of therapy in arthritis. As a physician particularly interested in physical therapy, I was eager to hear the comparison as I could see no conflict between physical and other therapeutic measures. Certainly physical therapy should not take the place of nor interfere with supportive measures of rest, diet, removal of focal infections, and so forth. It should certainly not take the place of gold, sulphur therapy, vaccine therapy and the several other more specific measures used in chronic infectious arthritis.

Our aim as physical therapeutists is not directed specifically against the cause of chronic infectious arthritis, whatever that may be, so much as it is against the effect. It is our purpose primarily to minimize deformity, or maintain or restore functional activity of affected joints and their supporting muscles. We can only do this first by being well grounded in the general field of arthritis and then by intelligently applying our specialized field.

Dr. Russell L. Cecil (closing): Dr. Currence brings out an interesting point that we all have to debate so often — that is, when a joint is actively and when it is not actively affected. Or we might go further and leave off the "affected" and simply say, when is a joint "active" or "inactive." This frequently comes up in dealing with the orthopedic surgeon in respect to a possible infection, and of course one goes a good deal by the appearance of the joint and the temperature of the patient. But the leukocytes have to be considered, the sedimentation rate, and other findings.

I agree with Dr. Currence that it is a most important point to determine the kind of therapy the patient should have. Certainly there is one thing we should all bear in mind in treating rheumatoid arthritis, and that is the extreme difficulty of curing the disease by any measure. The patients get better, reach an inactive stage, maybe even get rid of symptoms, but they have a very unpleasant way of relapsing, and I do not think any of us have any false modesty about our achievements in the curing of this very difficult, troublesome, and mysterious disease.

I quite agree with Dr. Bennett that there is no antagonism between medical and physical treatment. They go hand in hand and the title perhaps is somewhat misleading in this respect. But certainly no antagonism was meant to be shown.

In our clinic we depend on physical therapy a great deal and use it virtually on every case of arthritis we have to treat; but naturally, as medical men, we have to consider many other phases of the treatment, the etiologic agent, the type of arthritis anatomically, and the like. We have

(*Concluded on page 626*)

THE PENETRATIVE EFFECT OF COLD *

WILLIAM BIERMAN, M.D.

and

MAE FRIEDLANDER, Ph.D.

NEW YORK

The last half century has seen the development of methods for the creation of heat deep beneath the body's surface. The therapeutic possibilities of these conversive technics naturally held the attention of physicians especially interested in physical measures. The excellent clinical results frequently obtained by heat produced an enthusiasm which has obscured the therapeutic potentialities of the converse procedure — the abstraction of heat. It is possible that an important contributing cause to this indifference was the impression that conductive cooling has no greater penetrative influence than conductive heating. If some instrument had been invented for the conversive removal of heat comparable to the high frequency current now available for its production, the ameliorating influence of cold might have received more attention.

The fact is that cold applied to the skin and mucous membrane surfaces of the living human body can cause a substantial diminution of the temperature of tissues lying a considerable distance beneath these surfaces.[1] The extent of the influence in distance and in temperature depends upon the nature of the substance applied, its variation from thermal neutrality (i. e., the temperature of the body surface), the duration of its application, and the region upon which it is placed. Water is a convenient vehicle because of its capacity for absorbing heat (twenty-seven times greater than air), and its availability at low temperatures.

Regional Applications of Cold

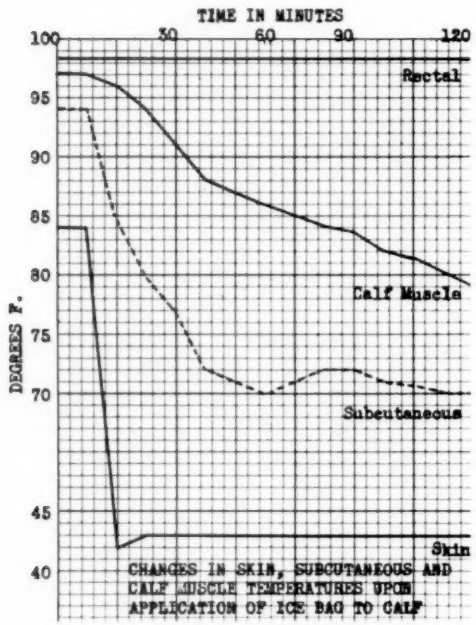
Cold Applied to the Human Leg. — The muscle temperature changes which occurred following the placing of an ice bag on each side of the human calf

TABLE 1. — *Muscle Temperature Changes of Human Calf by Ice Bag.*

Experiment No.	Temperature ° F.		Duration of Experiment	
	Initial	At End	Hour	Minute
1	97	85	1	30
2	97	87	2	....
3	95.4	69.2	2	....
4	96	77.2	1	40
5	93.8	79.8	2	....
6	93	78	1	50
7	92	78.8	2	....
8	95.3	75	2	....
9	95	80	1	40
10	96.4	80	1	30
11	96	79	2	....

are shown in table 1. It will be observed that calf muscle temperature was diminished as much as 26.4 F. Graph 1 illustrates the rate and degree of fall in one of our experiments. For the determination of muscle temperatures a two-inch needle thermocouple (Leeds and Northrup iron-constantan)

* From the Department of Physical Therapy, Mount Sinai Hospital, New York City. Aided by grants from the Council on Physical Therapy of the American Medical Association.
* Read at the Nineteenth Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, September 3, 1940.



Graph 1.

was inserted to its full depth. The thermocouple tip reached about two inches beneath the surface of that portion of the skin through which it was inserted and about one and one-half inches away from either ice bag. The accuracy of the thermocouple was checked at each experiment. The lowering of the temperature of muscles lying beneath the skin as well as that of the skin itself following the application of cold has been reported many years ago by Wertheimer,[2] Kellogg,[3] MacLeod and Taylor,[1] and others.

The blowing of cold air on the living human calf also caused a lowering in intramuscular temperature though to a far less degree than did the ice bag (table 2).

Table 2. — *Application of Cold Air to Human Calf.*

Experiment No.	Temperature ° F. Initial	Temperature ° F. At End	Duration of Experiment Hour	Duration of Experiment Minute
1	94.2	92.4	1	....
2	95	92	2	....
3	97	94	1	10
4	95.5	93	1	....
5	90	79	1	....

Alcohol poured on the skin surface diminished the subcutaneous temperature about 3 F. It did not influence the intramuscular temperature.

Cold Applied to Cheek. — A flat hollow metal applicator kept cold by circulating water through it (temperature 50-52 F.) was placed on the outer side of the cheek. The temperature of the inner side of the cheek in the corresponding area was measured by an alcohol thermometer, with the lower portion of its stem bent at a right angle so as to permit good contact between its circular flattened base and the buccal mucosa. The changes in the temperature on the inner side of the cheek are shown in table 3. Kellogg noted a fall in the temperature of the skin surface of the cheek when ice was held in the mouth.

Cold Applied to Rectum. — Table 4 indicates changes in the temperature of the posterior male urethra when cold water was circulated through a hollow metal applicator inserted into the rectum. The posterior urethral temperatures were determined by a thermocouple (made of iron-constantan)

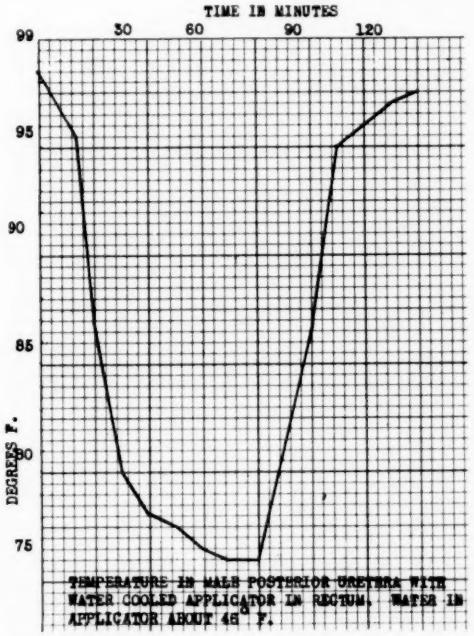
TABLE 3. — *Changes of Temperature on Inner Side of Cheek by Cold.*

Experiment No.	Temperature ° F. Initial	Temperature ° F. At End	Duration of Experiment Hour	Duration of Experiment Minute
1	96	86.8	....	24
2	96.2	85.4	....	40
3	95.6	84.3	....	50
4	96.5	84.1	....	32
5	97	85.5	....	32

TABLE 4. — *Temperature Changes of Posterior Male Urethra Following Cold Application Within the Rectum.*

Exp. No.	Urethral Temp. ° F. At Start	Urethral Temp. ° F. At End	Temp. of Water Passing Through Rectal Applicator	Duration of Experiment Hour	Duration of Experiment Minute
1	99.1	95.2	70	1	15
2	99.1	93.3	62	1	10
3	99	95.9	64	....	30
4	98.8	77.7	44	1	30
5	98.4	74.6	44	1	25

with its tip protruding through an opening at the end of a silk woven catheter. The catheter was pushed beyond the cut-off muscle. The thermocouple was permitted to remain in the posterior urethra during the course of the experiment. The greatest fall in urethral temperature was 23.8 F., occurring in experiment 5. This technic may be a valuable one for influencing diseases of the prostate gland (graph 2).



Graph 2.

Cold Applied to the Vagina. — A hollow metal cylindrical applicator was inserted into the vagina. It was cooled by circulating water through it. The

temperature of the vaginal applicator and the changes produced within the rectum and urethra as determined by mercury thermometers are shown in table 5. In experiment 6, the urethral temperatures were observed for ten minutes. The urethral thermometer was then pushed back into the urinary bladder. During the subsequent forty minutes the bladder temperature diminished from 91.8 F. to 86 F.

Cold Applied to the Abdomen. — Ice bags were placed on the region of the upper abdomen and determination of temperature changes taking place within

TABLE 5. — *Temperature Changes After Cold Application to Vagina.*

Exp. No.	Vaginal Applicator Temperature Initial	Vaginal Applicator Temperature At End	Rectal Temperature Initial	Rectal Temperature At End	Urethral Temperature Initial	Urethral Temperature At End	Duration Hour	Duration Minute
1	98	52	98	73.5	98	72	1	....
2	95	52.5	99	82	97.5	90.5	1	25
3	90	51	97	78	97	82	....	30
4	98	52	98	73.5	98	93	1	....
5	93.5	47.5	96.5	73	97.3	87.5	2	20
6	71.5	47	99.2	70	99.2	91	....	50

the stomach were made by a thermocouple incorporated into a Rehfus tube. The results are shown in table 6. The relatively slight degree of alterations

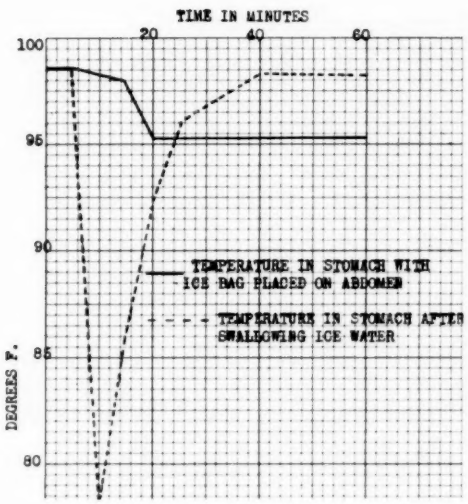
TABLE 6. — *Temperature Changes After Application of Cold to Abdomen.*

Experiment No.	Temperature ° F. Initial	Temperature ° F. At End	Duration of Experiment Hour	Duration of Experiment Minute
1	98.8	98.4	....	30
2	98.6	97.6	2	....
3	98.4	97	....	50
4	99	97.7	....	50
5	98.96	95.9	1	30
6	97.86	97	1	....
7	99.4	97.7	1	....

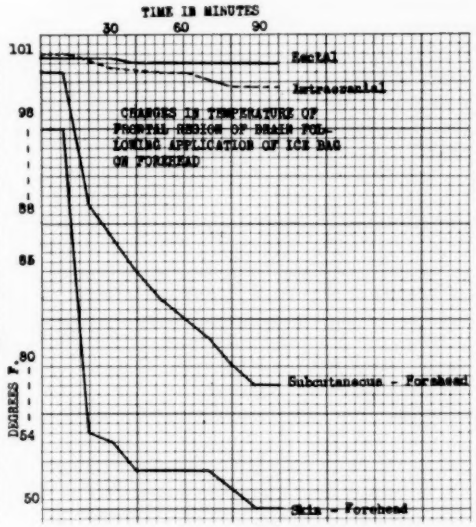
in stomach temperatures may be due to inaccuracies in the approximation of the ice bag on the abdomen and the thermocouple in the stomach. The relative position of these two objects as well as the nature and extent of the intervening abdominal contents was unknown. Kellogg found a lowering of the temperature of the epigastrium when his subject drank copiously of ice water.[3] In Selden's experiments cold applied for thirty minutes or more by an ice bag lowered the subjacent intraperitoneal temperature an average of 11.3 C. (20.3 F.) in twelve guinea pigs, an average of 7.2 C. (12.9 F.) in six rabbits, and 4.2 C. (7.5 F.) and 8.7 C. (15.6 F.), respectively in two human subjects.[5]

The drinking of cold water causes a prompt and marked fall in the temperature of the stomach (graph 3). Beaumont in his observations upon the stomach of Alexis St. Martin noted that the swallowing of cold water checked the formation of gastric juice.[3]

Cold Applied to the Head. — We had the opportunity of inserting a thermocouple into the occipital region of the brain in a human subject so that the sensitive thermocouple tip was about three inches away from the scalp against which ice bags were placed. There was no change in brain temperature. In another instance the thermocouple was inserted into the frontal region of the brain at an estimated distance of about two inches from the surface of the forehead to which ice bags were applied. In this subject a lowering of 1.5 F. occurred. The rectal temperature diminished 0.2 F. (graph 4). Only local anesthesia was employed so as to anesthetize the skin of the



Graph 3.



Graph 4.

scalp. The insertion of thermocouples through the trephined skull of a rabbit permitted the observation of brain temperature changes when a cold application was placed over the frontal regions of the head. A fall of several degrees took place. The rectal temperature also fell, indicating that in the anesthetized rabbit operated upon and treated in this manner, the temperature control of the entire body is markedly affected. The rabbitt's skull is very thin when compared with that of the human. Schüller,[6] in 1874, observed that the application of ice to the scalp of rabbits produced vasoconstriction of the cerebral vessels in trephined animals. MacLeod and Taylor also demonstrated a lowering of brain temperatures in rabbits when cold was applied to their heads. Similarly, lowered temperatures were produced in other regions of the rabbit's body, such as the liver and kidneys.

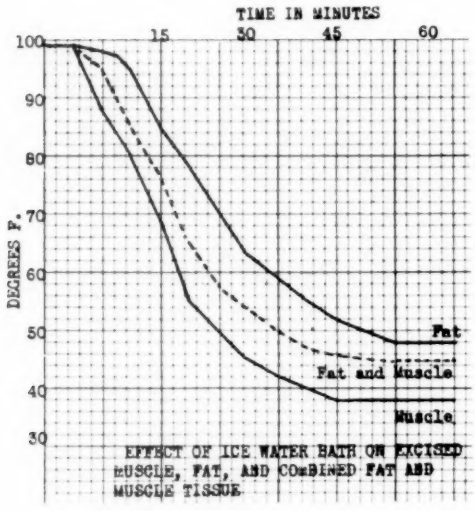
Remote and Systemic Effects of Cold

The remote temperature changes produced by cold have been described by several workers. Brown-Séquard,[7] for example, called attention to the fact that the immersion of one hand in cold water causes a lowering of the temperature of the other hand. Mudd[8] and his co-workers reported a lowering of 10.8 F. in the nares on chilling the body surface.

The ability to lower the temperature of the entire human body by immersion baths at a temperature of 40 F. was described by James Currie,[9] in 1797. His subject was a healthy man whose rectal temperature was quickly reduced from 97.5 to 83.1 F. Fleury,[10] in 1875, lowered the systemic temperature in a like manner. More recently Temple Fay[11] described a technic for the lowering of body temperature by cold applied to the skin surface.

Discussion

The cause of the rapid fall in tissue temperatures may be ascribable to prompt vasoconstriction as well as to conductive abstraction of heat. A comparison of the cooling curves in living human muscle and in excised mammalian muscle shows a striking resemblance (graph 5). It would appear that the living quickly approaches the avascular state of devitalized tissue. The effect is to limit heat loss. Whether the vascular change is due to pure nerve reflex[3] or to a variation in the concentration of some chemical substance[12] or to both, or there be some other explanation, we shall leave to others to discuss. The existence of a definite temperature gradient on



Graph 5.

exposure to cold, with the outermost tissues the coldest, and the relative insulating value of fat, indicate the importance of the physical factors involved.

The therapeutic possibilities of such applications have been appreciated for a long time. Thus ice bags have been placed upon the forehead to relieve headaches; upon the precordium to slow the heart rate; upon the abdomen for the pain of acute inflammatory processes, and upon many other areas for the care of acute local trauma. Further extension of the therapeutic use of cold may be expected, particularly after an increase in our knowledge of the physiologic changes produced by it. Thus Allen[13] has stated that "according to the experimental evidence, the method of ligation and refrigeration may find some valuable applications in surgery of the limbs, especially under emergency conditions." We have applied local refrigeration to two patients in whom embolization of the iliac arteries occurred as a complication in severe cardiovascular disease. While both of these patients died, it was remarkable how well preserved these devitalized extremities remained for a period of about two weeks in each instance. The gangrene and cyanosis did not spread and the usual fetid odor was absent.

Conclusion

Conductive cooling profoundly affects the deep local, distant local, and systemic temperatures of the human body.

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Discussion

Dr. Fred B. Moor (Los Angeles): Dr. Bierman has made a number of excellent studies upon the fundamental physiologic action of physical agents. The present essay is unusually interesting at a time when there has already been considerable attention directed toward refrigeration by the work of Fay and Smith. Believing that such basic investigation is essential to sound clinical application of physical therapeutic procedures, we have for many years been conducting experimetation of this nature. Some of it has been published, but much of it has not.

As the author has indicated, the cooling produced varies with the medium used for abstracting heat, the temperature of that medium, the initial temperature of the part treated, the duration of the application, and the particular region to which refrigeration is applied. Water is naturally the ideal medium for cooling because of its ability to absorb amounts of heat; it will be remembered that its specific heat is one which with very few exceptions is higher than that of all other substances. This paper demonstrates that local cooling varies directly as to time and temperature difference. I am interested in the part treated which obviously makes a great difference in the rate and amount of cooling. In the depth of the calf muscle at a distance of 1½ inches from the ice bag a decrease of 26.4 degrees was produced. Although slightly greater decreases were recorded for the urethral temperature with cold in the vagina, the proximity of the cooling agent is certainly a factor.

Sheard has shown that with heating, the vessels of the extremities are the first ones to open up, supposedly, with cooling they would be the first to constrict. Such vasoconstriction is, of course, a function of the autonomic nervous system and will naturally lower local temperature as has been repeatedly demonstrated. It is obvious, especially in the extremities, that vasoconstriction and penetrative cooling are synergystic and I am inclined to stress the former somewhat more than the author does.

Clinically, for many years I have employed the ice pack (cracked ice over flannel) for the acutely inflamed joints of rheumatic fever, acute infectious arthritis and in acute bursitis with very satisfactory results. I have never been able to justify the procedure on physiologic grounds since cold lessens blood supply, lessens leukocytic migration and local defense in general so far as we know.

Dr. O. Leonard Huddleston (Denver): First of all I wish to compliment Dr. Bierman on his wise selection of a problem of such fundamental importance — not only from the standpoint of broadening our knowledge of therapeutics but also from the point of view of advancing physical therapy along the lines of scientific principles. The use of heat and cold in the treatment of many diseases is still on a more or less empirical basis. We all are aware of the fact that some physicians advise patients to use heat in the treatment of certain conditions while other equally good practitioners prescribe cold applications for the same maladies. Some even tell their patients "to use hot or cold applications — whichever feels better." Furthermore, many physicians when asked why they prefer heat to cold therapy or vice versa, are unable to supply a satisfactory answer. When such conditions prevail it is evident that there is great need of extensive research work directed toward the establishment of fundamental principles in order to provide a rational basis for the therapeutic use of heat and cold. The observations of Dr. Bierman are indeed valuable in that they supply us with information regarding the extent of thermal changes in different regions of the body as a result of the application of cold. This is a necessary initial step toward the ultimate solution of the problem of "what physiologic changes occur in the tissues which are responsible for the therapeutic benefits when cold is applied." In addition to the therapeutic benefits we should ultimately learn something of the fundamental changes which may bring about any unfavorable or undesirable reactions should they occur. If the answers to these questions were known, we would be in a better position to understand the indications for the use of heat and cold applications.

From the standpoint of tissue reactions to cold we hope eventually to find out about the various changes that occur in the vascular system, pressure changes, volume flow, velocity flow of the blood and lymph, changes in the composition of the blood, lymph and tissue fluid, alterations in the caliber and in the permeability of

the blood and lymph vessels, the effects established in the defense mechanism (cellular and biochemical), the alterations in the functional activities of the nervous system and the extent and character of the effects of cold on glandular activity, glandular secretions and on the complicated enzymes system of the tissues which are concerned with tissue metabolism, growth, regeneration and repair. Perhaps most important of all is the knowledge of mechanisms by which these changes are brought about.

Fortunately some of these answers are known already. All are familiar with many of these changes and the mechanisms by which they are produced. Therefore, I shall confine my remarks to certain phases of the problem which are less generally known.

With regard to the nervous system, exposure to cold increases the frequency and the regularity of the rhythm of discharge of motoneurons. A fall in body temperature below a critical level of from 37 to 35 C. establishes intermittent and incoordinated twitches and is coincident with the first signs of a rise in oxygen consumption. As for vascular changes two reactions may be brought about by cold — a primary and a secondary effect. The primary reaction causes a constriction of the small vessels including the small arteries, arterioles, capillaries, venules and possibly the small veins. The ischemia thus established if continued for 10 to 15 minutes gives rise to a dilatation of arterioles and capillaries; the reactive vasodilatation produces hyperemia of the tissues. The primary reaction is caused partly by the direct action of cold upon the contractile tissue, partly by simple reflex vasoconstriction and partly by axon reflexes. The secondary reactive vasodilatation is believed to be caused by the formation and liberation of histamine-like or H - substances which produce vasodilatation of the capillaries by direct action and dilatation of the arterioles by axon reflexes. The reactive hyperemia may be absent under certain conditions: (1) generalized chilling of the body or lowering of the body temperature causes a contraction of the small arteries which becomes the dominant action; (2) when the localized chilling is quite rapid or when the cold penetrates the tissues deep enough to cause constriction of the small arteries, and (3) it is always absent when sensory fibers of the arterioles have degenerated.

In closing I wish to make one or two comments on the experimental work of Dr. Bierman which deals with temperature changes of the brain. It is my belief that the results would be considerably more significant if brain temperature determinations were made on dogs or cats instead of rabbits. The former animals possess more stable vasomotor and temperature regulating mechanisms. These regulatory mechanisms of rabbits are notoriously labile. It would seem desirable also to make some observations on unanesthetized animals.

Dr. William Bierman (closing): With reference to Dr. Moor's comments, as presented by Dr. Dail there are two assertions which he has made which I would like to comment upon briefly. One was the fact that one may secure a rise in systemic temperature, even though it be very small, on the application of local cold. I think that may well take place as a result of the body's effort to maintain the systemic temperature level, just as in the contrary application on the use of large amounts of heat, as in the induction of fever by physical means, the initial change in the rectal temperature is a fall in temperature, not a rise. In other words, the body compensates for heat loss in one area by increasing the possible metabolic activities, and it may overshoot a little in the process.

Now, as to the rationale of the application of cold in acutely inflamed joints or bursitis, Dr. Moor says he is at a loss to give a physiologic explanation for the clinical improvement. I think that explanation has been offered to us. Dr. Huddleston, in his discussion, refers to it. Dr. Landis showed that there are definite changes occurring in the venous and arterial side of the capillary loop and in the intracellular tissue spaces. With heat, there is a trend for the pressure values to rise within the closed vascular systems with corresponding diminution in tissue drainage, increased tissue fluids, and I believe increased tension between the cells.

Dr. Huddleston mentioned the advisability of further experimentation in animals other than rabbits. We only used rabbits in these intracranial determinations and then discarded our findings because we felt that the physiologic responses of the rabbit were so much different from those in the human. We have worked with cats and dogs in the converse consideration of temperature elevations, and it is true, as he said, that the temperature control of these animals is better than that of the rabbit, but nevertheless the temperature control is not at all as definite as it is in the human. The dog, for example, relies upon the rapid respirations and the extrusion of his tongue in the effort to lose heat. All of these are fur-bearing animals and they have not man's facility for heat loss.

While we unquestionably can gain a large amount of information, and I agree that experiments should be carried on, we were particularly interested in carrying on our experiments with the human for obvious reasons. I was anxious to get these basic determinations of temperature changes particularly in various parts of the human, and especially in the part like the human skull, where the thicknesses of bone are quite different from those of experimental animals.

INVESTIGATIONS ON INFLUENCE OF CLIMATOLOGIC FACTORS ON BLOOD SUGAR

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In previous papers[1, 2] it has been shown what comprehensive effects climate as a whole and each climatologic factor may have on the weight of organs, which means on the whole metabolism. In order to study these influences more in detail, investigations on the carbohydrate-metabolism have been carried out by experiments with animals under laboratory conditions and during an expedition also on human beings. In order to give a clear conception of the work, we classify it as follows:

1. Investigations with white mice by the comparative method;
2. Investigations with young pigs, and
3. Investigations with humans under influence of diminished air pressure, of the radiation of the sun, and determination of the amylactic property of the blood.

Investigations with White Mice

Since these investigations have already been detailedly reported in a previous paper, it will suffice to recapitulate the results which are shown in table 1.

TABLE 1. — *The Blood Sugar Content (Average Values in mg. %) in White Mice.*

Laboratory Experiments

Normal	High Temperature	Low Temperature	Visible Light	Ultraviolet Light	700 mm. Hg.	570 mm. Hg. 6 days	570 mm. Hg. 20 days
102	98	107	124	83	92	89	105

Expedition Experiments

500 m.		2200 m. 8 days		2200 m. 35 days		4250 m.	
Non-Irradiated	Irradiated	Non-Irradiated	Irradiated	Non-Irradiated	Irradiated	Non-Irradiated	Irradiated
172	188	119	138	98	161	113	100

It can be seen that high and low temperatures are without effect. Visible light increases, ultraviolet light decreases the blood sugar while an effect from diminished air pressure is doubtful. These results essentially agree with those of other authors except that Abderhalden found a certain relation between the temperature and the amount of blood sugar. A further explanation of these results will be given later.

On the expedition the diminished air pressure seemed to increase the blood sugar. Irradiation at the altitudes of 500 and 2200 m. caused an increase, and at the altitude 4250 m. a decrease. As will be shown later, these differences are connected with changes in the spectral composition of the sunlight at various altitudes.

The marked increase in Nalchik cannot be explained solely by individual climatologic factors. As already mentioned in the previous paper, the transition from Leningrad to Nalchik, including a four-day trip by railway,

possibly caused a "shock-like" effect on the whole metabolism manifested among other things in the increase of the blood sugar level.

Investigations with Young Pigs

The use of young pigs for biochemical investigations is new, so that there is no comparable material in the literature. However, these animals have two advantages for climatologic investigations: 1) Because of the absence of hair they are very suitable for all kinds of irradiation experiments; 2) it is possible to investigate the blood of the same animal several times so that during a longer period one can follow the changes effected by the climate.

The investigations were made at the same points as in the experiments with white mice, and under the identical experimental conditions. The results are shown in chart 1. The values of the fasting blood sugar fluctuate over a rather wide range. Since these fluctuations occurred in about the same manner in all investigated animals, one can suppose that they were caused by climatologic factors, the most important of which seems to be the diminished air pressure. Passing from Nalchik (500 m.), the native place of the animals, to Terskoll (2200 m.), in most of the animals an increase of the blood sugar was observed, followed shortly by a decrease under the initial value. If the animals remained at an altitude of 2200 m. (see part 2 and 4,

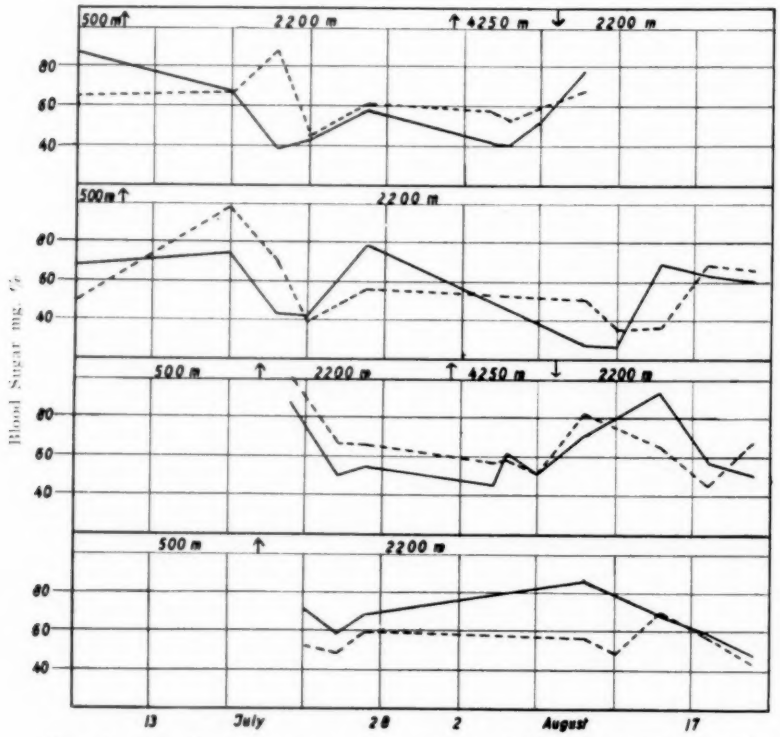

Chart 1. — The blood sugar content in young pigs (individual values in mg. %) at various altitudes.
——— Irradiated - - - - Non-irradiated
↑ and ↓ indicate transition from one altitude to another.

in chart 1), the initial value was reached after some fluctuations. Passing from Terskoll (2200 m.) to Priyut Deviati (4250 m.) the blood sugar became diminished in all animals. After the return to 2200 m. the blood sugar content again rose, reaching the initial value.

All these changes were observed in the same manner both in irradiated and in non-irradiated animals. From this it follows that the daily irradiation did not affect the ability of young pigs to react to the diminished air pressure. Also, the average blood sugar content in both groups was equal (60 and 61 mg.).

Investigations with Humans

The influence of diminished air pressure on the blood sugar content was determined at various altitudes while fasting and during sugar tolerance tests. Three points must be considered in analyzing the results obtained: (1) the blood sugar content at various altitudes; (2) the maximal value in the sugar tolerance test, and (3) the time of its occurrence.

The first is answered by the results shown in table 2. In nine individuals the blood sugar was increased by diminished air pressure, one showed no change, and in two a decrease was found. Thus, there is no unique influence

TABLE 2.—*Blood Sugar Content in Fasting Men (mg. %).*

Investigated	At Sea Level	At 4250 m.	Investigated	At Sea Level	At 4250 m.
Ba	90	115	K	90	93
C	95	114	Ab	93	95
Rei	87	106	Fr	86	85
B	90	103	Ki	100	96
Sa	88	100	Ru	102	96
Bai	90	100			
Shi	97	103	Average	92	101

of the diminished air pressure on the amount of blood sugar. The same conclusion was reached also by Abderhalden,[3] Messerle,[4] Wertheimer,[5] Baichenko,[6] and others.

Concerning the second and third considerations, it is possible to come to a definite conclusion. The obtained results will be discussed by means of chart 2, where typical blood sugar curves for one person at different times and at different altitudes are shown. Since the results obtained from the other investigated persons are about the same it is not necessary to present them separately.

In order to facilitate a comparison the curves show the changes in per cent, the initial value in all cases being 100, while the real initial values lie between 83 and 114 mg. Taking the "lowland" curve 1 as a *norm*, it can be seen that after five days at an altitude of 3000 m. the maximum of the blood sugar curve 2 is higher, but is reached in the same time. Until the end of the second hour, the curve falls off approximately parallel to the normal but then in contrast rises slightly. The observation of Messerle[4] that the maximum occurs at the higher altitude earlier than in the lowland could not be confirmed, but he made his investigations at a lower altitude.

Curve 3 shows the course of the blood sugar after a five days' stay at 4250 m. with a preceding stay of 11 days at 3000 m. The maximum is lower and it occurs later than in curve 1. Furthermore, a second, lower maximum exists after two hours. Curve 4 was obtained after a stay of 16 days at this altitude (4250 m.). It is parallel to the normal only on a lower level. The maximum is less, but is reached in the same time. A second maximum was not found. This is a sign of certain acclimatization.

The curves of the other individuals investigated at sea level and at 4250 m. have the same appearance. The increase was less than in the lowland in 11 cases, and greater in two cases. The maximum was reached later in 5 cases, earlier in 2 cases, and in the same time in 6 cases. A second maximum

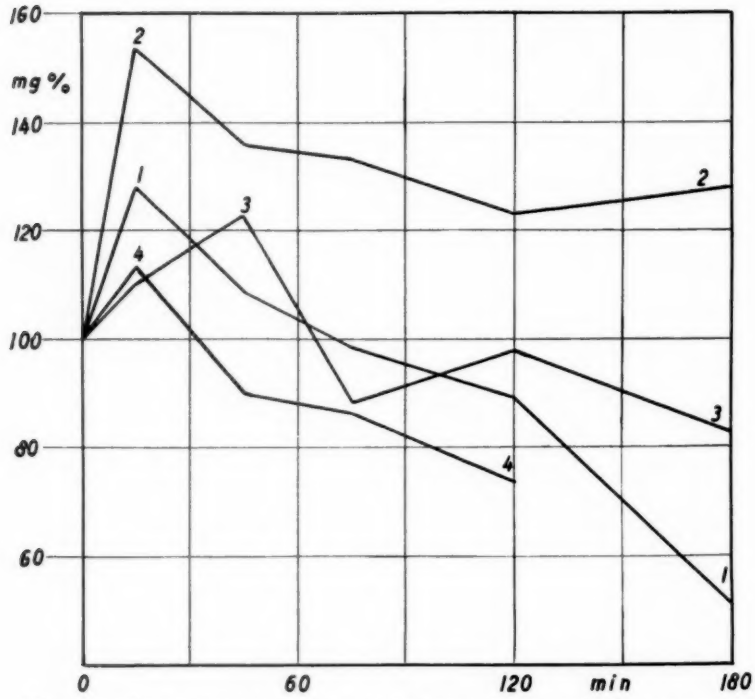

Chart 2. — Sugar tolerance test in a fasting man. Blood sugar time curves after intake of 50 Gm. sucrose; curve 1, on sea level; curve 2, at 3000 m.; curve 3, at 4250 m., 3 days after arrival; curve 4, at 4250 m., 20 days after arrival.

after two hours was found in 9 of 13 cases. All this shows the different capability of reaction and adaptation of different individuals.

Concerning human adaptation and acclimatization, it must be mentioned that the only man who dwelt four weeks at 4250 m. showed an entirely normal curve of blood sugar at the end. Thus, it appears that so far as the carbohydrate metabolism is concerned, four weeks suffice for acclimatization. This agrees with the observation of Messerle that at an altitude of 2400 m. acclimatization occurs after two to three weeks.

Discussion

From the above results in persons as well as in animals it can be seen that in most cases diminished air pressure causes a transitory increase of the blood sugar. According to the investigations of Goldberger[7] the organism distributes at the altitude of 2400 m. more adrenalin than in the lowland, thus increasing the blood sugar. This effect can be intensified by an acidosis which usually occurs at an altitude and by which the efficiency of adrenalin is increased (Frőhlich and Pollak). This is especially proved also by Monasterio.[8] As a primary reason it is assumed that the diminished air — which means oxygen — pressure causes an excitation of the sympathetic system, thereby releasing more adrenalin with all its consequences. By this mechanism Loewy[9] explains also the changes of the state of the blood at a higher altitude.

The observed increase of the maximum in the blood sugar curve, which occurs at 3,000 m., can also be explained by means of an excitation of the sympathetic system. But for higher altitudes this explanation is inadequate. There, too, the blood sugar is increased, but the maximum in the blood sugar curve is less and occurs later. Altmann[10] explained his similar observations by a diminished sympathetic tone caused by alkalosis. However, since he

investigated rabbits under other conditions and since there were no symptoms of alkalosis in the investigated individuals, this explanation is not valid. But if one supposes that the ingested sugar is burned faster, it can easily be understood that in spite of the enhanced efficiency of the adrenalin the increase of the blood sugar in the tolerance test is less. A proof of this supposition can be seen in the investigations of Durig and coworkers[11] that the respiratory quotient after feeding of sugar is increased at an altitude of 4,500 m. The combustion of sugar begins and is completed earlier.

Thus, if the lower maximum of the blood sugar curve is caused by faster combustion of the ingested sugar, it is still necessary to explain why in high altitudes the maximum occurs later than usual. Loewy and Cronheim[12] have shown that diminished air pressure causes definite changes in the liver. These changes occur in animals after 3 to 4 days and later disappear. Without doubt an altitude of 4,250 m. causes certain disturbances also in the metabolism of human beings, which is first noticed in the liver. An indication of such disturbances may be the observed retardation of the maximum in the blood sugar curve. Thus the sugar tolerance test represents also a functional test showing not only the perviousness of the liver for sugar but also to a certain degree its ability to transform the fructose of the sugar into glucose. As soon as acclimatization takes place the liver is restored to its normal ability, the retardation of the maximum disappears and after 4 to 5 weeks the blood sugar curve returns to normal.

As a further proof of the above supposition, it can be pointed out that the retardation of the maximum was still greater (about 75 minutes) when the experiment was carried out one or two days after the investigated person had returned from an ascent to the Elbrus (5,600 m.). At the same time also the second maximum occurred with a retardation (150-180 minutes instead of 120 minutes).

Finally, the second maximum may be discussed. Although slight fluctuations are within normal limits, the curves never show a second maximum during a period of 2 to 3 hours at sea level. Therefore, the second maximum must be considered as an effect of the altitude. Following the above explanations it must be supposed that as a result of the diminished air pressure the whole nervous system is in a certain unstable condition and therefore can be more easily influenced by external factors. On the other hand, because of lack of oxygen the ingested sugar is not burned completely, but forms more lactic acid than normally, which causes acidosis of the blood (Barcroft,[13] Hartmann[14]). This acidosis affects the unstable nervous system (sugar-center), thus causing a new distribution of sugar in the blood. As soon as the nervous system becomes accustomed or the deficiency of oxygen is compensated for by regulatory processes, the excitability of the nervous system disappears and a second maximum of the blood sugar is not observed in the course of two hours.

Influence of Radiation. — In addition to the investigations concerning the influence of diminished air pressure on the carbohydrate metabolism, the influence of radiation also was studied. The results obtained in white mice and in young pigs have been presented. The young pigs showed no effect of the irradiation. In white mice the visible light increased and ultraviolet irradiation decreased the blood sugar. According to these results, on the expedition the blood sugar was increased in the lowlands and in medium altitudes. However, in higher altitudes where the ultraviolet radiation is considerable the blood sugar was decreased.

To these experiments may be added some investigations which were made in children suffering from surgical tuberculosis. Two groups of 15

children each, from the end of June until the end of August remained on an open veranda day and night. The children in one group were irradiated each day with sunlight, the time being gradually increased from 5 to 30 minutes, while the children in the other group at the same time received an "air bath" in the shadow. In all these children the blood sugar was determined three times every month. The blood was taken in the morning before breakfast and before any treatments.

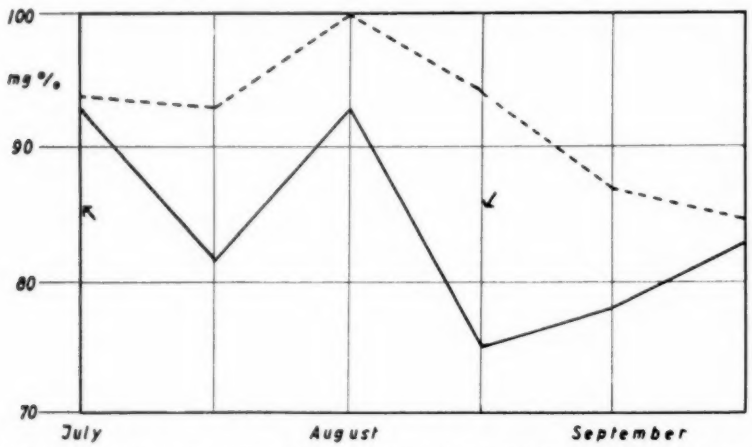

Chart 3. — Blood sugar content (average values in mg. %) in treatments with "sun baths" (————) and "air baths" (- - - -) ↖ and ↙ indicate beginning and end of the treatments.

The average blood sugar in each group from June until October is shown in chart 3. It can be seen that at the beginning and for some time after the climatologic treatment, the blood sugar in both groups has the same value. However, during the treatment the blood sugar level is less in that group which received a sunbath. Since all other climatologic factors were the same in both groups, this result shows that irradiation with sunlight causes a lasting decrease of the blood sugar in the types of tuberculous patients studied. This is contrary to the above results in white mice, but one must consider that apart from the difference in the organism, the duration of the irradiation was so great at variance that opposite results became possible.

In the above investigations of the influence of radiation, the blood sugar was determined on the morning following the last treatment. The effects noted lasted at least 24 hours. In addition it is important to study also the immediate effect of irradiation. Its results are shown in table 3. In most of the cases in both persons and animals the blood sugar is increased directly after irradiation.

In young pigs the average increase amounted to 45 per cent, while in the controls the fluctuations averaged 7 per cent. These experiments were carried out during the expedition at an altitude of 2200 m. At the same place, studies of persons were made which gave still clearer results. The average increase after the irradiation was 22 per cent while the controls showed practically no change.

Similar investigations were also carried out on the above-mentioned children in Leningrad. These experiments are very interesting because in addition to the blood sugar investigations the intensity of the ultraviolet radiation of the sun was measured. Table 4 shows the results of two days, during one of which the ultraviolet radiation was extraordinarily strong. On this day the blood sugar content was decreased in three of four

TABLE 3. — *Blood Sugar Content Before and After Irradiation (30 Minutes) with Sunlight at 2200 m.*

A. In Young Pigs

Day	Animal No.	Blood Sugar in mg. % Before	Blood Sugar in mg. % After	Blood Sugar in % Before	Blood Sugar in % After
Aug. 12	A 2	35	48	100	137
Aug. 16	A 2	61	91	100	149
Aug. 21	A 2	67	57	100	85
Aug. 16	B 3	49	64	100	130
Aug. 21	B 3	44	79	100	179
Aug. 16	B 4	46	63	100	137
Aug. 21	B 4	68	61	100	90
		Controls without Irradiation			
Aug. 21	B 1	47	48	100	102
Aug. 21	B 2	49	61	100	124
Aug. 21	A 3	65	62	100	96

B. In Persons

Day	Investigated	Blood Sugar in mg. % Before	Blood Sugar in mg. % After	Blood Sugar in % Before	Blood Sugar in % After
Aug. 14	Dor.	90	85	100	95
	Pol.	94	172	100	183
	Pro.	87	116	100	133
Aug. 19	Gol.	90	101	100	112
	Daw.	97	96	100	99
	Gal.	85	93	100	109
	Sem.	76	94	100	123
		Controls without Irradiations			
Aug. 19	Pro.	98	93	100	95
	Shi.	87	87	100	100
Oct. 28	Pro.	80	76	100	95
	Kro.	88	94	103	106

TABLE 4. — *Blood Sugar in Persons Before and After Irradiation (30 Minutes) with Sunlight at Sea Level.*

Investigated	August 3 Blood Sugar in mg. % Before	After	Investigated	August 11 Blood Sugar in mg. % Before	After
Kal.	106	126	Rom.	89	89
Gaw.	106	115	Rum.	72	69
Mich.	115	126	Scht.	96	87
Tschern.	103	118	Osip.	96	81
Kow.	99	120			
Average	106	121	Average	88	81
Intensity of Ultraviolet Radiation of Sun.	9	50			

investigated patients, while on the other day the usual increase in the blood sugar after irradiation was found.

Discussion

According to the investigations of Rothmann,[15] Pincussen,[16] Messerle,[4] and others, it is generally supposed that by irradiation with sunlight the blood sugar is decreased. Inasmuch as the same effect can be obtained by ultraviolet radiation, the above authors considered this part of the radiation as the only active agent and they thought that the effect is due to a decrease of the sympathetic tone or an increased excitability of the parasympathetic system. All these considerations are related to the reduction of blood sugar which can be noted only some time after the irradiation.

In later investigations Pincussen[17] found that the wavelength of the radiation is of great importance, the ultraviolet decreasing and visible light and infra-red radiation increasing the blood sugar. The present investigations confirm these observations in both humans and animals. Beyond it they show that apart from the wavelength, the time element is likewise important. The fact that the measurable effect of an irradiation can be opposite, depending on whether the blood sugar determination is made directly or 24 hours after the treatment, and that various wavelengths may produce different results, renders it probable that there is no single mechanism responsible for the influence of radiation.

It is striking that the effect of ultraviolet radiation has at least a certain similarity to that of insulin. Therefore it is to be supposed — and previous authors have already asserted it — that the pancreas takes part in the reaction mechanism. In order to obtain some information in this direction, the amylatic property of the blood was investigated, the results of which will be given here.

Amylatic Property of the Blood. — During the expedition some determinations of the amylatic property of the blood were made. The method used was hydrolysis of added glycogen and the determination of the amount of formed glucose. Since this method — as also for all other proposed methods — is not unobjectionable, the values will be given only in relative units.

Table 5 shows the amylatic values of several persons at altitudes of 2200 and 4250 m., while table 6 shows the values before and after a 30-minute irradiation with sunlight. The results are uniform. At an altitude of 4250 m. the amylatic value of the blood is decreased as compared with that at 2200 m.

TABLE 5. — *The Amylatic Property of the Blood in Relative Values at Various Altitudes.*

Investigated	At 2200 m.	At 4250 m.
Mor.	1,78	1,03
Chal.	1,67	1,14
Shi.	1,22	0,40
Pro.	1,95	0,63

TABLE 6. — *The Amylatic Property of the Blood in Relative Values Before and After Irradiation (30 Minutes) with Sunlight at 2200 m.*

Investigated	Before	After
Dor.	1,62	3,57
Pol.	1,60	3,80
Pro.	1,85	1,40
Gol.	2,00	3,75
Gal.	0,65	3,22

Concerning the effect of irradiation of 30 minutes the experiments show in four of five cases a distinct increase of the amylatic property. This is considered an effect of the radiation (table 6).

The amylatic property of the blood has always been spoken about, but not the amount of amylase. These are two different phenomena which should not be confused. Of course, this is not so easy because judging only after a chemical effect (hydrolysis of glycogen) it is not possible to distinguish between the amount and the activity of the ferment. However, this is important because it has been shown by Cronheim[18] that the activity of amylase can be increased by irradiation with visible light. Therefore, the above strengthening of the amylatic property by irradiation can be caused either by an increase of the amount of amylase or by a greater activity, or by both of them.

Likewise ambiguous are the relations between the amylatic property and the amount of blood sugar. An increase of the amylatic property can mean that the distribution of amylase is intensified and the ferment is on the way to the deposits of glycogen to intensify the hydrolysis of glycogen,

thus increasing the blood sugar. This would explain why both the amylatic property and the blood sugar are increased by irradiation.

The opposite direction in diminished air pressure (increasing blood sugar and decreasing amylatic property) cannot be explained. It is possible that there exists no relation at all between these two constituents, each being regulated by its own mechanism. This supposition also would explain why a definite connection between the blood sugar level and the amylatic property of the blood could not be established.

Summary

The influence of several climatologic factors on blood sugar was investigated in persons and animals (white mice and young pigs) in an expedition and under laboratory conditions.

In high altitudes, with the diminished air pressure the blood sugar is increased in most of the cases.

The sugar tolerance test shows distinct changes at various altitudes which disappear after three to four weeks.

The observed changes are explained by excitation of the sympathetic system caused by a deficiency of oxygen; accelerated combustion of carbohydrates; and temporary disturbance of the function of the liver.

The amylatic property of the blood is decreased by diminished air pressure.

The immediate effect of irradiation with visible light is an increase, that of ultraviolet radiation is a decrease of the blood sugar.

If visible and ultraviolet radiation act at the same time, as in sun-baths, the immediate effect depends upon the proportion of the intensity of both kinds of rays. Since the after-effects of the ultraviolet radiations seem to be stronger, the final effect of irradiation with sunlight is in all cases a decrease of the blood sugar.

The amylatic property of the blood is increased by irradiation with sunlight.

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(Concluded on page 626)

NASAL IONIZATION: ITS PRESENT CLINICAL APPLICATION *

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Nasal ionization, as a rational therapeutic measure for some types of nasal pathologic processes, is well established and practiced by many outstanding men in rhinology. The types in which this method of treatment has been successfully employed include:

1. Seasonal hay fever, alone.
2. Seasonal hay fever associated with asthma.
3. Hyperesthetic or vasomotor rhinitis.
4. Hyperplastic rhinitis — i.e. — the type associated with polyp formation.

There is great variation in the reported results from ionization in seasonal hay fever and asthma. In some instances, as high as 80 to 90 per cent of cases have been reported cured or relieved of symptoms, while other authors deny beneficial results to be obtained from this method of treatment.

Much more uniformity of results is reported, however, by ionization in hyperesthetic or vasomotor rhinitis in, that, nearly all reports show some relief of symptoms. The degree of relief claimed or admitted in the reports of different men varies greatly. My purpose in this brief resumé of the present clinical status of nasal ionization is not to evaluate the relative merits of the results reported with such wide variations in the literature, but to point out some factors which are favorable for its success and others which prevent success.

I have used only the technic described by Warwick and, for the sake of the record will say that in a recent communication from Dr. Warwick, he states that he has made no change in his original published technic except that he uses the jell instead of cotton strips saturated in the electrolyte, inserts the electrode wrapped in cotton and dipped in water or the electrolyte solution. The time and other factors remain the same.

Results of the experimental works of Shaffer,[1] Molitor,[2] Turrell,[3] Friel,[4] Burke[5] and others, from ionization of lesions of the skin and mucous membranes in various parts of the body outside the nasal areas, in which they found no permanent harmful effects to either of those parts or to the subcutaneous and submucosal tisues or to any remote tissues of the body, encourage us to assume until proved otherwise, that ionization of the nasal tissues according to the standard technics in present practice is entirely safe from the standpoint of permanent injury.

Hollender[6] made histologic studies on the effect of ionization on nasal tissue. He found that a change resembling fibrosis resulted in the subepithelial tissue and that no harmful clinical effect had been observed over a period as long as ten years.

Alexander[7] and his co-workers report that the greatest relief is obtained from ionization in patients having an intumescent nasal mucosa and at the same time a minimum of reagins in the nasal tissues and in the blood.

Hansel[8] states that cases with a high degree of sensitivity and definite positive skin reaction give poor results in ionization.

Linton[9] stresses the fact that the best results from ionization are in patients who do not react to topical application of allergens to the nasal mucosa and that

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the poorest results are obtained in individuals showing marked reactivity in the nasal mucosa after applying allergens.

Weille[10] has found that ionization is indicated only in patients showing marked instability of the nasal mucosa.

Dean[11] asserts that the most favorable cases for ionization are:

1. Those having a maximum of chronic rhinitis and a minimum of allergy.
2. Patients having an intumescent nasal mucosa due to endocrine abnormalities, and, he advises that a basal metabolism test be made on patients having allergic rhinitis.
3. Those patients in whom the leukopenic index is not changed after the ingestion of specific foods.

Vaughan,[12] as an allergist makes a liberal concession to the value of ionization in the statement that patients with vasomotor rhinitis in whom an allergic cause cannot be demonstrated; possibly also those who have failed to respond to allergic therapy, even though an allergic excitant has been demonstrated, may be benefited by ionization properly applied.

Alden,[13] whose experiences have been outstanding in the use of ionization, says that desensitization is still the method of choice in the treatment of seasonal hay fever, but in those cases where this method has been adequately but unsuccessfully tried, ionization is indicated. He states, however, that ionization has its greatest usefulness in perennial allergic (i.e. intumescent) rhinitis.

Hollender tabulates indications for ionization in the following conditions: Simple chronic rhinitis, so-called intumescent rhinitis, nasal polypoid tissue, vasomotor rhinitis and seasonal hay fever. His experience, with ionization in seasonal hay fever, is at variance with the great majority of those who have reported their results.

Warwick,[14] whose work has given great impetus to nasal ionization in the past several years, employs ionization in seasonal hay fever and reports very encouraging results.

When men of national prominence demonstrate widely differing results in apparently the same type of cases with the same method of treatment, it is pertinent to seek an explanation since there are perhaps other causes than the personal equation of those making the reports. My own experience with ionization has given results parallel with all these reports in that I have had both good and bad results in conditions of all the types mentioned above with the same method of treatment. My impression is, after checking my own results, that there are certain factors not universally observed, which mitigate against success in the employment of ionization and therein lies the explanation of the lack of harmony in the reports.

Indications

The factors for the success of ionization are:

1. An intumescent type of nasal mucosa.
2. A minimum of reagins in the nasal tissue or in the blood.
3. Nasal passages free of mechanical obstructions.
4. Correction of endocrine factors that might be contributory to the nasal affection.
5. Stability of the leukopenic index following the ingestion of specific foods.
6. Freedom from acute infection of the sinuses.
7. The antra or maxillary sinuses free of residual secretions.

It will be noted that all the above factors bearing upon the success of ionization, except the last one named, have been stressed by various authors to whom credit has been duly given. The harmful influence of residual secretions in the antra, while implied by Hollender and others, has not received the emphasis which in my experience and observation it merits.

It is my practice to irrigate through the natural ostium for both diagnostic and therapeutic purposes all antra in which there is reason to suspect any chronic involvement. In virtually all cases showing a chronic reaction in the mucosa of the nares, there is found a residue of secretions in the corresponding antra. Conversely, after the residue is evacuated, the mucosa in a short time resumes its normal appearance in a degree proportional to the completeness with which the corresponding antra remain free from the influence of the secretions. These observations cause me to believe that any treatment of the types of nasal disease under discussion will succeed only as it results in maintaining the accessory sinuses free of residual secretions. The rationale of ionization is based upon the same premise. In the first place, all etiologic factors must first be corrected, if possible. The effect of ionization, histologically, is to cause fibrosis and consequent shrinkage of the nasal mucosa. In those cases in which such shrinkage promotes drainage conditions in the middle meatus, relief will result in proportion to the completeness of the drainage. If drainage conditions in the middle meatus are not improved by the ionization, no relief will be experienced. If secretions drain out for awhile and then reaccumulate, then intumescence will return as a result of the presence of the secretions. Ionization, no doubt, in many cases causes enough shrinkage in the middle meatus favorably to influence the drainage of the anterior group of sinuses, and to that extent I believe it has an established value in otolaryngology.

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PHYSICAL THERAPY OF VARIOUS MANIFESTATIONS OF BRUCELLOSIS (UNDULANT FEVER) *

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Physical therapeutic methods are used in so many conditions, especially in chronic illnesses, that it may seem unnecessary to devote an article to its use in brucellosis. The vast majority of cases (especially of chronic brucellosis) go undiagnosed and never receive specific or other therapy. Kern[1] said: "The diagnosis is obviously difficult. It takes the use of everything at our command in the way of diagnostic procedures — agglutination reaction, skin test, blood cultures, phagocytic index determination — but above all it takes a knowledge on the part of the doctor that the disease exists and must be considered in every case of protracted fever or other ailment of an infectious nature that he can't get to the bottom of." For the past several years I have endeavored to stress three points: (1) that there are thousands of cases of brucellosis under our very noses that are being diagnosed as neuroses or as infections of other origins; (2) that diagnostic methods have attained a high degree of accuracy which makes it incumbent upon us to stop ignoring this infection, and (3) that therapeutic methods are available that will yield a high percentage of actual cure or at least clinical recovery.

Among these therapeutic procedures specific vaccine therapy, chemotherapy and physical therapy must all receive their proper degree of attention. As in many other illnesses, physical therapy alone is usually inadequate but, as an adjuvant, its importance can hardly be over-emphasized. The only exception is in the use of artificial fever therapy which in itself may prove to be curative and which will be discussed later. Feldman,[2] among others, reported on the use of diathermy, roentgen rays and ultraviolet irradiation in the treatment of brucellosis and concluded that these measures, together with specific means, play an important part in the management of the disease.

Gould and Huddleson, in 1938, estimated that about 10 per cent of the population of the United States had become infected and that probably one per cent of these infected persons are ill with brucellosis at any given time. Interpreted, these figures, which agree with the author's estimate of several years ago, mean that while an actual census made on a given date would probably reveal 120,000 persons actually ill with the disease, any of the 12,000,000 infected persons may be added to that census as their infections wax and wane. What percentage of infected persons have minimal, latent or subclinical infections has never been determined but our estimate of the tremendous number is steadily increasing.

In the light of this high incidence of infection with Brucella, it is not as astounding as it at first seems that Goldfain[3] reported that approximately 51 per cent of 157 patients, the great preponderance of whom were suffering with "rheumatic disease," yielded a positive diagnosis for brucellosis when skin, agglutination and opsonocytophagic tests were done. He reported that improvement varying from moderate to marked degree and apparent cure occurred in a total of 90 per cent of 23 cases adequately treated with Brucella bacterin. These statistics indicate that an important, and perhaps large, percentage of cases of run-of-the-mill arthritis are actually caused by Brucella infection and that their treatment by physical therapeutic and other means cannot be adequate

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unless the etiologic factor is recognized. It must be pointed out that the incidence of Brucella infections is greater in rural regions where raw milk is consumed and that Goldfain's cases were mostly referred from outlying towns in Oklahoma where pasteurization of milk was not practiced. It must not be assumed however that the possibility of brucellosis in the city dweller can be dismissed, as is too commonly done. The vast majority of urban and suburban inhabitants do take vacations and motor trips in the country where too many of them, unsuspectingly or deliberately, obtain "pure, raw milk." "Pure, raw milk" is said with all the irony possible, for the chances are just about even that such milk is anything but pure. Accurate surveys have shown that infection exists in 36 per cent of the herds in the United States. Hogs, horses, sheep and other domestic animals may also transmit the disease to man.

Articles on arthritis are still appearing in our best journals by well-known authorities in which brucellosis either is not mentioned or is accorded but little space and importance. The entire November, 1937, issue of *Medical Clinics of North America* was devoted to a symposium on arthritis. Brucellosis as a cause was considered so relatively unimportant that only two and one-half pages were given over to "Arthritis in Brucella Melitensis Infections" out of the 303 pages. Hardy,[4] who contributed this brief article, described arthralgia in 36 per cent and as a prominent complaint in 7 per cent of the cases of brucellosis in Iowa, where the porcine strain of Brucella accounts for about one-third of all cases of brucellosis. Multiple, shifting joint involvement was described. He mentioned one case of hydrarthrosis due to brucellosis, referring to the descriptions of this manifestation of brucellosis by others. The early observations of Hughes,[5] in 1897, were at variance with those of Hardy and other later writers in that 30 per cent of his acute cases of brucellosis developed joint effusion; the joint involved was usually swelled, hot, tender and excruciatingly painful, rarely showing redness, usually of short duration but often affecting one joint after another. Simpson[6] found that 10 per cent of his brucellosis patients had joint symptoms as an outstanding complaint. Many others, including Levine, Myers and Leggett; Antonine and Coulon; Sandstrom;[7] Gautier;[8] Roger;[9] Sharpe;[10] Kulowski;[11] Manson-Bahr;[12] Goldfain; Baker, and others, have written on bone and joint involvement due to brucellosis. The organism has been cultured from joint fluid in many instances. I have pointed out that arthritis due to Brucella infection is not always acute and that most often it simulates the slow going chronic atrophic arthritis of other causes

In a recent address before the session on physical therapy of the Medical Society of the State of New York, Wyatt, Hicks and Thompson[13] devoted the main part of their effort to treatment of arthritis by physical measures. Etiology was discussed only incidentally, but Brucella infection as a cause of arthritis was not mentioned. The multiple routine tests had not been done. This instance and the one before are quoted to show that the four diagnostic methods are not commonly used in general or special practice and that diagnoses are quite naturally not made. To diagnose arthritis and to treat it by physical or other means, without exhausting the possibilities of uncovering the etiologic factor results in many an avoidable error, wasted effort and failure of therapy.

Neuritis, bursitis, sacro-iliac pain, sciatica, arthritis in its various manifestations, osteomyelitis, and like conditions due to Brucella infection need not be described in detail; it will suffice only to mention them and to discuss the treatment by physical measures of the numerous manifestations of brucellosis encountered in every-day practice. Some conditions are mentioned partly to point out wherein physical therapy is helpful or curative; others are discussed to stress the fact that we may place too much emphasis on this method to the exclusion of more specific measures.

An excellent example of the latter cases that are treated by physical means without accurate diagnosis is shown by an error of mine which could hardly fail to have been duplicated by others. A patient presented a hot, red, tender, painful erythematous patch on the lower leg so typical of erysipelas that a positive diagnosis was made at once and a prompt response to ultraviolet irradiation was promised. Instead of recovery within a few days there was gradual enlargement of the skin infection, gradually mounting temperature and increasing malaise and lassitude. Ultraviolet irradiation was repeated, this time in massive dosage but without improvement. In spite of a third application there was further slow progression and then, quite suddenly, an orange-red macular-papular rash appeared above the erysipeloid lesion, three weeks after the onset of the illness. These lesions were typical of those previously seen and recognized as due to brucellosis. A blood specimen for agglutination test with *Br. abortus* was positive, Brucella vaccine therapy was instituted and there was complete resolution within a week of the original and the secondary lesions, coincident with drop of temperature to normal and disappearance of the constitutional manifestations.

Unfortunately no color photographs were made of this condition. A monochrome film was made however. The patient remained well for two years before a similar but smaller area of erythema appeared on the leg in nearly the same location, accompanied by similar constitutional manifestations. No time was wasted with ultraviolet irradiation on this occasion; vaccine therapy was instituted and the response was even more prompt than before. Kodachrome films of this recurrence were made. All of my patients responded promptly to specific vaccine therapy and/or sulfanilamide. In all cases, had not the original error served as an object lesson, a diagnosis of erysipelas would have been made and ultraviolet light prescribed. Two of the patients might well have succumbed to their infection.

In 1937 I[14] stated: "Injuries such as sprains of joints, may result in symptoms and signs out of all proportion to the trauma, in patients with brucellosis, apparently due to the localization of the morbid process in injured tissue where it is apt to remain until specific treatment is instituted." Not until two years later did I see an article by Kennedy,[15] published in 1904, in which he stated: "The organism must be in the circulation, if not constantly, at least in certain stages of the disease. One is able, in many cases, to assign some external exciting cause for these local affections, viz. exposure (Hughes), twist, strain; the region of the shoulder joint is very commonly affected in hospital patients and is undoubtedly caused by the patient trying to reach something on his bed-side table and over-reaching himself."

An example of trivial trauma causing an extensive pathologic process occurred in a woman of 58 who had been quite well until this illness save for a recurrent anemia. Her only injury was a slight twist of her right shoulder occasioned by reaching up to put out her bed-light in October 1937. The shoulder became rapidly more painful and motion progressively more limited until there was complete crippling at the time she consulted me in April 1938. The arm was carried in a sling fixed to her side; no motion was possible without agonizing pain. Radiographs showed peri-arthritis of the shoulder and calcareous bursitis. The shoulder was moderately swelled and very tender. Brucellosis had not been suspected during her previous observation and daily treatment which included a month's stay in an excellent teaching hospital with physical measures, including short wave diathermy. Although there had been no improvement under this previous regimen, ultrashort wave diathermy and massage were given under my direction and was attended by moderate improvement. About 25 per cent of the function of the arm returned and pain was somewhat lessened. There was arrest of improvement in spite of continued treatment. The possibility of previously latent chronic brucellosis was then considered and therapeutic test doses of

vaccine were given. There was definite local, focal and general reaction followed by dramatic improvement. About 90 per cent of the range of motion was restored within the next six weeks and pain had virtually disappeared. Ultrashort wave diathermy and massage were continued throughout the period of vaccine therapy for their obvious value. Physical therapy alone could not bring about recovery in this as in many other instances.

Other examples of the worth as well as limitations of physical therapy in various forms of Brucella infection must be omitted because of lack of time. Those who do the multiple tests for brucellosis will find that many otherwise unexplainable and incurable conditions are actually due to chronic brucella infection and that where surgery, drug therapy and physical therapy have failed to influence recovery, a large percentage will yield to a combination of properly adapted physical methods and specific vaccine or chemotherapy.

There are many other indications for physical therapy in the amazingly protean manifestations of brucellosis, especially in its chronic form. In some instances the methods are palliative only — in others actually curative. The majority of the symptoms and syndromes caused by brucellosis will yield to specific vaccine therapy alone in the chronic disease or to sulfanilamide in the acute phase. There are other conditions in which the combination of methods is of vital importance. This is especially true of foci of infection such as in the gallbladder (which may be acutely or chronically infected or may simply harbor the organism), the fallopian tubes (acute or chronic salpingitis) and the prostate.

In cholecystitis complicating brucellosis (and presumably due to this infection) I have had clinical and radiographic evidence of the effectiveness of six-meter diathermy through the liver and gallbladder in several patients in whom *Br. abortus* vaccine alone had accomplished only partial recovery. Complete recovery followed the addition of this agent in long series of treatments to the specific vaccine regimen, either through aid in actually ridding the viscus of the organism or through simply improving the state of the gallbladder by increasing its circulation. That such instances may be due to Brucella infection is shown by the personal experience of Evans[16] whose blood agglutination test was negative but whose blood and bile cultures (obtained by duodenal drainage) were positive. Recovery in her instance followed removal of the gallbladder, from which Brucella was also cultured. Whether to advise extirpation of the gallbladder or the more conservative and time-consuming ultrashort wave diathermy must, of course, depend upon the age, physical condition and cooperation of the patient. Recoveries following vaccine therapy combined with ultrashort wave diathermy may be followed by relapses, which though usually easily controlled suggest the desirability of surgical removal whenever feasible.

Pneumonia due to Brucella may resolve very slowly, as pointed out by Beatty[17] and others. Short or ultraviolet wave diathermy is of decided help in inducing resolution in such instances. In pneumonia due to the common incitants, in patients with chronic brucellosis, there may be exacerbation of the brucellosis due to lowering of resistance and secondary invasion of the lung indicating the need for diathermy as well as specific measures.

Ultrashort wave diathermy is referred to throughout this article because of my conviction that there is a great difference in effectiveness in infections of these very short waves as compared with short or long wave diathermy. Without any desire to introduce a controversial topic, it seems necessary to re-state this viewpoint. There is no intent to argue that the 6 meter is preferable to the 3 or 9 meter wavelengths, although the former technic seems the most practical as well as the most effective.

Salpingitis due to Brucella infection furnishes another example of the value of diathermy in eradication of a focus of infection which may otherwise prevent

recovery. In one of my patients spontaneous abortion had occurred three times. Vaccine therapy alone resulted in marked improvement but incomplete recovery. There were repeated recurrences of salpingitis accompanied by a profuse malodorous, purulent vaginal discharge from which *Brucella abortus* was isolated. Following the addition of pelvic diathermy there were no further attacks, the discharge stopped and complete recovery followed. No vaccine or other treatment has been given for more than three years. The term recovery rather than cure is used nevertheless. The tendency of chronic Brucella infections to recur is too well known to those who have worked with it to allow of anything but the greatest conservatism in prognosis.

Technic

The technic of treatment with physical measures is, of course, as important in brucellosis as in other conditions and perhaps more so in view of the stubbornness of this infection.

Other physical measures, as hydrotherapy, natural and artificial sources of ultraviolet light and the spa regimen in the chronic forms of brucellosis complicated by anemia, arthritis, neuritis and the so-called "run-down states" are of obvious value.

Artificial fever therapy may outrank all other measures in this field of medicine as a curative agent of the systemic infection itself. In a recent personal communication Krusen[18] stated: "Although our number of cases is still small, we are convinced of the value of fever threapy in the treatment of brucellosis. In fact, Doctor Prickman, of our clinical staff, feels that it is the treatment of choice." He further remarked that recently they had come to believe that it may be possible to get even better results by combining sulfanilamide therapy with fever therapy, saying that they have not enough evidence to report these observations however. In a report before the staff of Mayo Clinic in 1938 Prickman, Bennett and Krusen[19] reported the use of the Kettering hypertherm in 18 cases of brucellosis, 9 treated in the Mayo Clinic and 9 by Krusen's technic in other medical centres. Each patient was given three sessions of fever at three-day intervals, maintaining at each session a sustained rectal temperature of 105 to 106 F. for five hours. They allowed the patients to be ambulatory if their clinical condition permitted. There were seven "cures" and 2 failures in the Mayo Clinic cases and 8 "cures" and 1 failure in the 9 cases of other investigators. It may be significant in analyzing these results that 2 of the 3 failures occurred in cases of relatively long standing (1 and 2 years respectively), and that the majority of the cases reported as cured had existed from a few weeks to a few months. However, one case of 1 year duration, one of 2½, and one of 4 years' duration were reported as cured.

One cannot fail to remark that these patients are spoken of as cured although they were observed for periods of only one to several months following the conclusion of treatment. Cure is too broad a term to apply to any patient who has had brucellosis just as it is in tuberculosis. The likelihood is that the microorganism remains with the patient indefinitely, causing relapse whenever resistance fails to balance the infection. It would seem more accurate to say that the acute phase was cured, or better still to speak in terms of recovery rather than cure.

In discussing their report, Prickman remarked: "In evaluating the results of any treatment of undulant fever it always should be remembered that [the] disease is self-limited and the use of the term 'cure' therefore should be avoided." It is to be seriously questioned that brucellosis is a self-limited disease. Actually the infection has been shown by many observers to relapse after a period of many years in patients not exposed to re-infection. The acute phase truly is self-limiting but the chronic phase, alone or punctuated by acute exacerbations, may

be of indefinite duration, again as is true in tuberculosis. Prickman remarked that the present clinical impression was that fever therapy is indicated and is most efficacious in the acute or subacute febrile stage. He ventured the opinion that fever therapy should be tried in cases of chronic lesions of the bone, with or without sinuses, from which an organism of the Brucella strain can be cultured. He stated that, as a rule, fever therapy should not be given to patients over 50 or to those with respiratory, metabolic or cardio-renal-vascular disease. He suggested greater care in the selection of cases than had been practiced. Zeiter,[20] in 1937, reported his favorable impression of fever therapy in brucellosis.

Foshay,[21] in a personal communication stated that a number of patients with chronic brucellosis who had come to him for review had had one or more trials of fever therapy before he saw them. He remarked: "This only tells me that this form of treatment fails in some patients." I agree with Foshay's observation that "with a disease that can relapse spontaneously as late as six years after apparent recovery, I think a post-therapeutic observation of four years should be adopted before attempting to derive figures from experimental therapeutic results."

Kendell[22] has had considerable experience in this field. In a personal communication he stated: "Our experience with the use of artificial fever therapy in the treatment of Brucella infections has all been in the chronic phase. Practically all patients referred to us have had various types of treatment previously, largely vaccine therapy. It is our impression that those patients presenting a more active picture when treatment is instituted have had a more dramatic result. In the chronic group, where there is little doubt about the diagnosis, which presents clinical and serological evidence, we feel that artificial fever offers more than any other type of treatment alone." Kendell agreed with Krusen that this seems to be the treatment of choice and that the more active the disease, in the chronic form, the better the results obtained. He pointed out the possibility that some cases of brucellosis, diagnosed on the basis of positive skin test alone, may not actually have been suffering from this disease. I would stress the necessity for the most painstaking diagnostic procedures as well as consideration of the history and physical findings, before making a diagnosis of chronic brucellosis. The relatively recent addition of the opsonocytophagic test to our diagnostic measures has been of great help.

The question arises whether this new method has been used a sufficiently long time to allow a definite conclusion, as pointed out by Foshay. One of my patients in whom spontaneous hyperpyrexia due to brucellosis with a temperature of 107.2 F. occurred repeatedly over a period of years theoretically should have recovered without subsequent specific treatment if high fever alone were a curative mechanism. There was the possibility of re-infection in this patient, however or of a peculiarly resistant strain of Brucella.

Summary

Brucellosis, a common disease especially in its chronic form, is often undiagnosed.

Diagnostic methods have attained a high degree of accuracy. Therapeutic methods are available for the successful treatment of the disease in its acute and chronic forms.

Physical therapeutic methods, alone or combined with specific vaccine or chemotherapy are discussed.

Arthritis, simulating the atropic and hypertrophic forms of other causes is due to Brucella infection in some instances. This etiologic factor is still largely ignored in the current literature.

Many other manifestations of brucellosis masquerade under the picture of various types of inflammatory conditions.

Skin lesions, due to Brucella infection, may be a source of great confusion because they may closely simulate erysipelas leading to improper therapy.

Treatment of specific infections by specific agents, plus physical adjuvants, gives gratifying results in many otherwise hopeless states.

Slight trauma in patients with brucellosis, even though latent, may initiate localized processes of great severity, in which physical therapy is of great value.

Ultrashort wave diathermy is of value in inaccessible foci of infection, such as in the gallbladder and fallopian tube.

The 6 meter wave is preferable to longer waves.

Artificial fever therapy gives some promise as a curative method It is too early for accurate evaluation.

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IMPROVED INHALATION THERAPY OF ASTHMA

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The adjuvant value of 1:100 epinephrine solution in the inhalation therapy of asthma is well known[1] and has been reviewed elsewhere. In the nebulization of solutions of adrenalin (epinephrine) salts containing 1:100 of epinephrine hydrochloride or 1:100 of epinephrine phosphate by the usual method, certain difficulties may be encountered, however. The patients complain that they do not know when the nebulizer functions properly because they can not readily see the mist which disappears rapidly. Further, the dosage is uncertain, and psychologically, therefore, the technic may be inadequate. The method which has been developed by the writer is generally applicable to the nebulization of any dissolved substance as well as of epinephrine salts.

Theory

Before discussing the method of producing nebulization it is important to distinguish clearly between an atomizer and a nebulizer. Aside from the difference in the construction of the two (which is readily observable in the usual commercial models) their effects are quite different. In the nebulizer the size of the spray droplets differs from the atomized droplets in that the former is smaller and therefore not as readily observed. The therapeutic effects of each also are quite different because the larger atomized droplets produce different topical pharmacologic effects. An atomizer may not replace a nebulizer for the following reason: when an atomizer is employed with a 1:100 solution of an epinephrine salt (or concentrations at about that strength) it produces droplets which are so large that a great deal of absorption and local irritation occurs in the mouth and in the throat; indeed, some may be swallowed with unpleasant results. The problem in the treatment of asthma consists of getting small droplets in very large numbers as deeply into the lungs as possible with a nebulizer. As the air is drawn in with inspiration, the mist which is formed during successful nebulization is carried with the respiratory movements of the air into the lungs. This movement is essentially a convection process. When the bulb of an atomizer, however, is suitably compressed the movement of the droplets of the spray produced by the atomizer is primarily due to the momentum imparted by the blast of air. In the case of the nebulizer, however, the spray should be mist-like or fog-like and carried along with the air currents into the lungs. For this reason, it is important in treating the lungs in the asthmatic state with a 1:100 solution of epinephrine to use a nebulizer which produces a fine, permanent mist.

On observing the nebulization of solutions of epinephrine of the strength mentioned, it is usually observed that although a good mist is formed it disappears rather rapidly as the mist leaves the tip of the nebulizer. Accordingly, an insufficient quantity of the material may be carried by the inspiratory (convection) movement into the lungs. It would appear, therefore, that the droplets as ordinarily formed in the nebulizer not only evaporate rather rapidly but frequently an insufficient number is formed to produce a mist sufficiently permanent to be readily inspired by the patient.

The problem involved, then, is to produce by nebulization a larger number of visible particles and to control the life-period of the droplets dur-

ing treatment so that a more permanent mist results. An examination of the following equation discloses that not alone is the vapor pressure important in droplet formation and permanence but the radii of the droplets, the density of the material and the surface tension of the droplets may also be involved. At equilibrium, the transfer of liquid from a droplet of radius r, to another droplet of radius r_1 is,

$$\log \frac{p_1}{p_2} = \frac{M}{RT} \frac{2\sigma}{d} \left(\frac{1}{r_1} - \frac{1}{r} \right) \tag{1}$$

where p is the vapor pressure, σ, the surface tension, d, the density, M, the molecular weight of the liquid and R the gas constant. In other words, it would be quite difficult from a theoretical examination of the equation to know just how all of these variables could be controlled. It seemed likely to me that an examination of all of the parameters separately might lead to control of droplet size, number, and stability. After preliminary consideration and experiment it was decided to scrutinize most carefully the roles played by vapor pressure and nuclei formation as well as surface tension in mists suitable for the therapy of the lungs.

Experimental

It seemed especially desirable to plan experiments for the study of the effects of substances which would be present in sufficient quantity to lower the vapor pressure of the small droplets which, according to equation (1), distill more rapidly and hence disappear because their vapor pressure is higher due to high surface curvature. Therefore, substances like potassium chloride, sodium chloride, triacetin, monoacetin, ethylene glycol, urea, sorbitol, dextrose and glycerol in sufficient concentrations were employed in nebulization experiments. With the type of commercial nebulizers employed in the treatment of asthma, pure glycerol, itself, cannot be nebulized with ordinary pressure. The viscosity in this case is another parameter, not in equation (1), which prevents nebulization of the highly viscous glycerol. However, on forming saturated solutions of potassium chloride or of sodium chloride in water, or on adding sufficient amounts of any of the substances mentioned in the foregoing to the solution a complete change occurs in the nature of the nebulization as compared with the solvent alone. Depending on the concentration, the addition of these substances markedly enhances the ease of nebulization with the production of mists which have a more permanent character. These mists also contain a larger visible number of droplets. Since potassium chloride and sodium chloride do not lower but raise the surface tension, it is evident that the surface tension factor in this process need not be important.

Saturating water with KCl at room temperature increased the degree of nebulization with mist formation markedly improved. But only a slight increase in the efficiency of nebulization was observed when water was only 1/5 saturated with KCl. It is not necessary, therefore, to have a liquid dissolved in the solution which is nebulized, but a sufficient amount of solid substance like potassium chloride, the sugars, urea, or salts. These substances act as nuclei for the formation of more permanent mists as well as any effect that they may have which is embodied in equation (1). It is important to note that we have rejected the notion of the necessity of using isotonic solutions in therapy. This rejection will be subsequently justified by clinical experience. Quite a number of preparations used in the therapy of the nose contain isotonic salt solutions or isotonic sugar solutions. How-

ever, these quantities are not sufficient in amount to produce the high degree of nebulization required in the treatment of the recesses of the lungs with substances like epinephrine. As far as I am aware the role of suitable concentrations of nuclei-forming substances in the nebulization therapy of the lungs has not hitherto been recognized.

Evidently, when the nebulizer produces a mist under the special conditions conducive to nuclei formation above described, the curvature of the droplets is very great. However, the vapor pressure of these droplets is decreased by the addition of substances which can lower the vapor pressure and produce a permanent mist.

Clinical Application

Because of the fact that glycerine is not toxic and has been used in high concentration by direct applications to the nasal mucosa as well as to the pharynx, it was decided to study glycerine solutions of epinephrine in the nebulization therapy of asthma. High concentrations apparently do not lead to any irritation of the lungs or any damage to the patient. Indeed, a 50 per cent solution of glycerine containing 1:100 of epinephrine base as phosphate has been used by an asthmatic 58 years of age for a period of 16 months with an average of 5 cc. per week for 4 months with no irritation of the throat or of the lungs. In addition, the sweet taste of the glycerine and its soothing effect on the pharynx makes this vehicle most desirable. Substances other than glycerine (urea, sugar), in addition to those previously mentioned, have also been employed. But, at present, the experiments on a large number of cases have only been carried out with glycerine. For nearly two years I have used glycerol and epinephrine as indicated routinely in private practice and in the series of asthmatics described elsewhere with excellent results and no untoward effects.[2]

It is evident, also, that mixtures of the foregoing substances, say of sugar and glycerine or sugar, glycerine, and urea, could also conceivably be used. Other substances which have the same effect upon the lowering of the vapor pressure could be employed for other types of inhalant therapy. For example, potassium iodide plus glycerine solutions could be employed for nebulization. But, as we are at present not concerned with that type of investigation but rather with the results in the nebulization treatment of asthma, these data must await further communication.

In actual practice from 10 to 50 per cent glycerine has proved serviceable and has been used fairly regularly by eight intelligent patients for one year who found difficulty with ordinary aqueous solutions in commercial nebulizers.* But 50 per cent is the concentration of choice.

There are many correlated clinical problems, such as the introduction into the lungs of ammonium salts, iodides, enzymes like the mucoid splitting lysozymes, endocrines like insulin, and the like. These await further experimentation.

* Typical formulae used by me may be varied considerably using the principles outlined.

1. Epinephrine Hydrochloride	1 gm.	2. Epinephrine Base	1 gm.
Chloretone	0.5 gm.	Chloretone	0.5 gm.
Sodium Bisulfite	0.1 gm.	Sodium Bisulfite	0.1 gm.
Water	50 cc.	Water	40 cc.
Glycerine	50 cc.	Molar Phosphoric Acid	5.2 cc.
		Glycerine	50 cc.

More than 10% glycerine is required for suitable effects. The pH of the epinephrine phosphate solution should be between 4 and 5.

Summary

In the inhalation therapy of asthma, ordinary solutions of 1:100 epinephrine salts do not produce mists of suitable character. The number of visible mist particles may be increased and the permanence of the mist may be enhanced by controlling the vapor pressure of the droplets comprising the mist. The theory, experiments, and clinical application of this problem are discussed in detail.

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TECHNIC IN SHORT WAVE THERAPY *

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Up to the present time there are no clinical facts or experimental evidence which indicate that short wave currents have any other action on cells except through the effect of heat. There is a large array of clinical reports and divergent views, and a lack of uniformity of methods of treatment and absence of full records. Short wave diathermy is an important adjunct in the treatment of many conditions but there is no condition in which it alone acts as a curative agent. Schliephake implies that regulated motion of molecules generates heat plus some other potent force. As a result of this hypothesis claims are made that short wave has a selective thermal action, physiologic effects not ascribable to heat, specific biologic and specific bactericidal influences. These claims today have been proved false by many outstanding investigators such as Holzer, Eidenow, Coulter and others.

Northwestern University and the Council on Physical Therapy of the American Medical Association have conducted numerous experiments and have made over three hundred measurements of temperatures with many different machines and technics. As a result of these investigations, it was found that the most efficient and convenient method for giving short wave diathermy was the cable and coil technic of the electromagnetic induction method. They also found that the output of many apparatus differed, and as a result some were found less efficient than others. The Council has a complete booklet on accepted apparatus for the information of the profession.

There has been no conclusive evidence in the literature that one wavelength has any more significant effect than another. Twelve experiments were conducted by the Council in which such tests were performed and wavelengths ranging from six to twenty-five meters were used. These tests were made on volunteer medical students. Thermocouples were inserted into the quadriceps muscle of the thigh and temperature readings were taken in the skin subcutaneous tissue, muscle, and in the mouth, both before and after the application of the short wave current. These experiments confirmed previous findings that there are no significant differences in the heating of live human muscle or fat with varying wavelengths of short wave diathermy. Additional experiments in pelvic heating

* Read at the Mid-Western Sectional Meeting of the American Congress of Physical Therapy, Minneapolis, March 7, 1940.

were conducted using nine, fifteen, sixteen, and twenty-four meters, and here also it was found that there was no specific action with various wavelengths. The study of these data indicated that the rise in temperature was not due to the difference in wavelength but to the method and technic of application.

There are three methods of applying high frequency: first, the conventional long wave diathermy; second, the electric field of short wave therapy; third, the electromagnetic induction method. Inasmuch as I am confining this paper to short wave technic as employed at Michael Reese Hospital, I shall not include conventional diathermy.

In the electric field technic we have two electrodes which, when placed in position, produced a condenser field between them. This is electrostatic in nature. The methods used are:

1. Double cuff electrode.
2. Cuff and pad.
3. Pad electrode.
4. Air-spaced electrodes.

The following general considerations govern the electric field technic:

1. There should be sufficient bath towelling or felt between electrodes and skin. Too much padding causes too little internal heat and insufficient padding causes superficial tissues to become too hot and burns are apt to occur. Therefore, most manufacturers supply with each machine the proper thickness of padding.

2. Electrodes should not be applied over clothing. It is necessary that the exposed part should be inspected before and after treatment is given.

3. It is advisable to guard against accumulation of sweat. Any pricking or hot spots should be reported by the patient at once, as blisters may occur. It is well to remember never to disregard a complaint of hot spots.

Dosimetry in the field of short wave is not accurately worked out. The only guide we have, at the present time, is the patient's skin tolerance.

Accepted method of grading dosage:

1. Keep within comfortable feeling of skin warmth.
2. In painful conditions such as neuritis or neuralgia and acute inflammation — start with just enough current for heating of comfortable warmth and then decrease it just below that sensation so that the patient has practically no sensation of heat.
3. In chronic inflammation one may vary the energy output from a comfortable warmth to a more intense heat, just below the grade in which sensation of burning begins.

If we have any information that skin tolerance is subnormal, the heat sensation should be tested with test tubes of hot water. It is well to insert at this point the general rules which should govern the application of short wave therapy:

1. Instruct the patient that short wave should produce only pleasant warmth and that any unpleasant sensation should be immediately reported.
2. Remove all metallic objects.
3. Treatment tables and chairs should be free of metal parts.
4. When any bony part projects outward and the patient complains of a painful sensation stop treatment. This is due to overheating of the periosteum.
5. Separate electrode from the skin with Turkish towels or terry cloth.
6. In hot weather, when patients perspire, be careful that the towelling does not become moist.

7. When treating with heat, watch for headache and dizziness. If such occurs, stop treatment immediately and place patient in reclining posture and apply cold compresses to head. Resume treatment when symptoms have abated.

8. In heart disease watch carefully and reduce intensity if the pulse is accelerated.

9. Do not permit patients to regulate the current. Be sure to have a signal system or someone near who can regulate the current.

The great majority of short wave apparatus are equipped with thermionic tubes, the advantages of which are:

1. Oscillations of higher frequency.
2. Oscillations undamped.
3. Oscillations at uniform amplitude.
4. Operate silently, need no adjustment except replacement of worn out tubes.
5. Only one control.
6. Simpler to apply.
7. Heating more uniform.
8. Less danger of burns.

The following are descriptions of the various technics in the electric field:

Double Cuff Technic. — 1. Its use is limited to the extremities and should be considerably larger than the part being treated. This allows the current to enter the patient's body at as low a density as possible and thus remain below skin tolerance at this point.

2. Encircle the extremity completely for overlapping does not harm.

3. In placing the electrodes, put one distally and one proximally on the part being treated. There is a maximal distance of separating the cuffs by which the most heat is generated in the muscle. In placing the cuffs on the part be sure that the extremity is fully extended, especially the knee or elbow, as one may get current arcing when the ends of the electrodes are too close together. One-half inch of towelling should be between the electrode and the skin.

Cuff and Pad. — This is used for the wrist, hand, ankle and foot, and the dosage is regulated in accord with the patient's tolerance. Place the hand or foot on the condenser and one-half inch towelling between the part to be treated and the electrode.

Pad Electrodes. — Here too the dosage is regulated in accordance with the tolerance of the patient. Experimental work by the Council has shown that this is the most inefficient technic for deep heating, the effect being mostly superficial with very little heat in depth. This is because the area of entry for the current into the body is less than cross section of the part to be treated.The current entering the body is at its greatest density in the portion immediately near the surface of the skin and heat generated there is greatest — thus giving the patient a most intense sensation of heat. The current spreads in all directions and seeks the path of least resistance through the body. As the current density rises in the particular conductive area, the rise causes the current to seek out less conductive areas to pass through. This gives a rapidly decreasing current density as the current leaves the area of entry into body.

There is an electrical law that the heat generated by a current decreases as the square of the density of the current per cc, therefore, the current is going to decrease very rapidly in density as it leaves the area of entry into the body and the temperature generated decreases as the square of the density per cc. It is apparent that the amount of temperature rise generated to any depth is practically nil with the pad electrodes that are comparatively much less in size than the cross section of the part we are trying to heat. Thus with this technic

we get a high surface temperature with very little heat in the depth.

Air-Spaced Electrode Technic. — Here also the dosage is regulated by the patient's tolerance.

The ability to heat the deep tissues of the human thigh is dependent upon:

1. Size of electrodes.
2. Energy available from apparatus.
3. Method of application.
4. Distance of electrode from skin.
5. Patient's tolerance.

In experimental work performed with these electrodes, with a machine of high output and with two five-inch air-spaced electrodes, both placed on the anterior surface of the thigh, one distal and the other proximal to the part being treated and the distance of the electrode nine to eleven inches from center to center, it was possible to raise the temperature in the deep muscles to 106.6 F. With a machine of less output and four-inch electrodes, duplicating the above technic, the temperature found was 102.3 F., thus showing that the capacity of the machine and the size of electrodes are important. The purpose of the air-gap between the skin and electrode is to lessen the danger of skin burns and to produce a cooling effect. The technic found to be the most effective is the one in which the electrodes are placed in the same plane as described in the first experiment.

Electromagnetic Technic. — In the electromagnetic induction technic, the current is induced into the patient. For this a heavy insulated flexible cable is used and an alternating magnetic field of the same frequency of alternation as the current in the coil. Any electrically conductive material placed within this electromagnetic field will have induced within a voltage causing "eddy currents" of electricity flow, the frequency of which will be the same as that flowing in the coil. Therefore, the "eddy currents" induced in the tissue will produce heat and no neuromuscular response, since the frequency of the "eddy currents" is far above that which elicits muscular contractions. The human body is composed of material of different electrical conductivity, thus, when this is placed within the coil the heating develops in the various constituent materials and will vary with their electrical conductivity; the maximum intensity of the "eddy currents" and heating will occur in the tissues of greatest conductivity. The heating of tissues is in direct proportion to their electrical conductivity.

There are two technics described in electromagnetic induction:

1. The loop.
2. The pancake coil.

The things to remember with regard to these applications are:

1. Avoid metal tables and inner spring mattresses.
2. The cable between the terminals of the machine should be even and four inches apart. If too close there will be shunting and a bypass will be produced thus reducing the efficiency of the current.
3. Failure of the current to oscillate may be due to: (a) too close coupling between electrode cable and patient; (b) too many turns or loops in it for a given distance between table and patient.

Local Applications of Short Wave Technic. — The part being treated should be bare and in a position of physiologic rest.

For the extremities or their articulations the technic should be as follows:

1. Wrap one-half inch towelling around the part.
2. Three turns of cable.
3. Place cable loops 1 inch apart (wooden separator).

4. Connect cable to terminals of short wave machine and see that they are even and four inches apart.
5. Turn on current to a comfortable heating of the skin.
6. Duration of heat ten to thirty minutes.
7. Follow the application of short wave with infra-red or radiant heat.

Both Knees Technic. — 1. Place one-half inch thickness of towel between knees.
2. Wrap one-half inch thickness of towelling around both knees.
3. Three turns of cable around both knees 1 inch apart (wooden separators).

Shoulder. — With the patient in a sitting position and with the arm resting on the treatment table, wrap one-half inch thickness of bath towelling over shoulder and around arm and loop three turns of cable around, or a pancake technic may be used with one-half inch towelling around the shoulder with the patient sitting in a chair and the arm resting on a pillow. The patient may also lie on the treatment table, in which case one should use three or four turns of cable, which should be held in place with a light sandbag.

Sinus and Ear. — Place two turns of cable on pillow and over cable place one-half inch thickness of bath towelling.

Eyes. — One-half inch towelling over eye, two turns of cable over eye.

Back - Hip - Chest - Pelvis. — One-half inch thickness of towelling two to three or possibly four turns of cable, pancake of nine inch diameter using wooden separators to keep coils 1 inch apart.

Prostate. — One inch thickness on chair — pancake three turns, cover coil with pillow or blanket so that coils are one inch away from patient. Elevate the scrotum, separate from the thighs with towelling to prevent overheating.

Contraindications

There are certain contraindications which should be mentioned at this time as follows:

1. Acute inflammatory processes, acute non-draining cellulitis — acute infectious arthritis.
2. Hemorrhage, actual or potential.
3. Disturbances of sensation — peripheral nerve injuries.
4. Pregnancy (through abdomen — low back — pelvis).
5. Menstruation.
6. Malignant growths.
7. Disease or injuries in which simpler methods of applying external heat give satisfactory results.

PHYSICAL THERAPY AND BRONCHOSCOPY *

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NEW YORK

This paper deals with such physical therapeutic methods which can be applied through the bronchoscope. This is a narrow field, yet it has been extended considerably since such methods were first used in bronchoscopy, and there is reason to hope that the extension will continue. This hope will all the sooner be realized if the two specialties cooperate wholeheartedly.

My first experience with physical therapy during a bronchoscopic procedure was in connection with the removal of a benign adenoma of a bronchus. This was a fairly large, sessile growth which periodically blocked the left main bronchus. The result was a massive collapse of the lung and severe illness. A number of attempts were made to remove that growth, first with biting forceps, then by implantation of radon seeds. These attempts failed completely. In desperation I improvised a long electrode and applied a coagulating current through the neoplasm. This blanched it completely and in two weeks the growth disappeared. Since that first success, I have used such a procedure on a number of similar cases. I have found that it is not necessary to coagulate the whole growth but only touch it in several places, preferably about the base. This seems to result in such a destruction of vitality as to bring about disappearance of the neoplasm.

As regards the strength of the current, seemingly it is better to have it sufficient to cause instant blanching about the tip of the electrode, a weaker current applied for a longer time being less controllable. Some operators advocate a monopolar current for the destruction of these or similar growths. The reason for advocating a bipolar current is that these benign adenomas are liable to have extensions deep in the wall of the bronchus. If a monopolar current is used, the penetration is not sufficiently deep to destroy the entire lesion and so recurrences take place. There is no doubt however that for superficial growths the monopolar current is very successful.

I have used the coagulating current in two other classes of bronchial lesions. The first of these is tuberculous ulceration of the bronchi. When I first used this method in such lesions it seemed to be very successful. The patients got well very promptly. Then I found the healing came about with the formation of very tough scar tissue and in one or two cases a tight stricture of the bronchus was produced. This difficulty might have been overcome by using a weaker current and less extensive coagulation, but then the procedure proved to be dangerous. When a coagulating current is used the destruction is just as deep as it is wide. This does not matter when a thick tumor is attacked. But when a flat ulcer is being coagulated the whole bronchial wall may be penetrated. In one of my cases I opened a large blood vessel and severe hemorrhage resulted. This led to the adoption of a method of treating tuberculous ulcers which will be described later.

The third class of cases on which I have used the coagulating current is varicose veins of the esophagus, carried out through the esophagoscope. Experimentally it has been shown on dogs that the large veins of the neck can be instantly shrivelled by the touch of a coagulating electrode. I have attempted the same thing in two patients with varicose veins of the esophagus who suffered from hemorrhage. Although the veins immediately attacked disappeared

* Read at the Eighteenth Annual Session of the American Congress of Physical Therapy, New York City, September 6, 1939.

without disaster, the difficulty and danger of the procedure forced its abandonment. Perhaps someone more courageous with an improved technic will take it up again.

At the present time a large part of my experience with physical methods is in connection with tuberculosis of the trachea and bronchi. The existence of these lesions has been known for a long time, they being seen exclusively at the autopsy table. Bronchoscopy has shown them to be astonishingly frequent. They are encountered in the form of ulcers, tumors, and scar tissue strictures of the bronchi. The existence of scar tissue proves that many of them undergo spontaneous healing. For this reason some authorities do not advocate their bronchoscopic treatment. It has seemed to me that their healing could be accelerated by treatment.

Methods

The first method used was electrocoagulation. I have already stated for what reason it was given up. Chemicals, chiefly silver nitrate of various strength were then resorted to. These brought about speedy healing but, like coagulation caused excessive scar tissue. Recently a mercury vapor lamp has been used. This is a very small lamp, affixed to a long insulated rod for passage through the bronchoscope. The high frequency apparatus used is one which delivers a small current, adapted to the small lamp. This method applied at weekly or bi-weekly intervals appears to heal tuberculous lesions of the bronchi in a short time with a minimum of scar tissue. The time of course varies considerably according to the nature of the lesion. It will be understood that an ulceration involving only the mucous membrane gets well much more quickly and surely than one involving the whole thickness of the bronchial wall. As to the amount of scar tissue produced, it should be understood that no ulceration can heal without some scar formation. Some methods, however, in themselves produce scars, which are added to those of the healed lesions. It seems that such an intrinsic scar of the method is reduced to a minimum by the mercury vapor lamp.

It has been stated that the result of healing of tuberculous disease of the bronchi either spontaneously or by treatment, is scar tissue formation. This may be small and cause no trouble. If, however, it is extensive there may result a stricture of the bronchus. Under some circumstances there is no harm, but if there are infected cavities beyond the stricture, a dangerous sepsis may be produced. It then becomes necessary to dilate the strictured area in order to drain the abscesses. Bronchoscopists have used various appliances to do this, such as "glove stretcher" dilators, or bougies. These methods are difficult to use, cause a good deal of trauma, and are not effective because the scar tissue soon contracts.

An attempt has been made to overcome these difficulties by negative ionization. I employ copper tipped bougies through which a current of less than five milliamperes is passed. These dilate the stricture just as any bougie will. They also have the effect of softening the scar, so that after a few treatments the lumen of the stricture remains open. This is brought about without trauma at the time of bronchoscopy and without bad after affects. I have found it possible in a number of cases to dilate and maintain in that condition some very obstinate strictures. The effect on the abscesses beyond the stricture has been correspondingly favorable.

Some experimental work has been done on dogs which may be of interest. Using thirty-five per cent silver nitrate several bronchial strictures were produced. Various methods of dilating these were investigated, and it was the ionization which proved most satisfactory.

In the course of the work on the strictures another use for ionization was found. It is sometimes very useful in tuberculous cases completely to close a

bronchus. This necessity arises when the lung has been almost wholly replaced by scar tissue, and yet it is not possible to close a cavity or cavities by pneumothorax or operation. It has been noticed that when the main bronchus to such a lobe or lung closes spontaneously, the cavities will disappear and the patient will be much more comfortable. This closure of bronchi has been done chiefly with chemicals. On dogs it was found that a fairly intense positive galvanic current would bring about a quick closure of the bronchus. This also seems to be the effect in human beings. So that if the closure of bronchi proves to be a valuable treatment in some cases of tuberculosis, positive ionization should be the method of choice.

I wish now to suggest one or two newer fields for physical measures in bronchoscopy. One of our active endeavors is the management of lung suppuration, such as abscesses or bronchiectases. Many of these cases recover spontaneously, or under medical treatment; some recover after repeated bronchoscopic drainage, while the remainder is subjected without question to surgical intervention. There are certain cases which almost fully recover after bronchoscopy and it seems that if a little more could be done one would produce complete recoveries.

It is well known that many suppurative cavities, such as chronic suppurating ears can be dried up by ionization with a weak zinc chloride solution. Reasoning from this, one wonders if the same method could be applied to small lung abscesses and small areas of bronchiectasis. There is no difficulty in filling the cavities with a solution. Whether it could be retained there during treatment and what would be the dangers are questions yet to be answered.

We have tried ionization on dogs with seemingly no bad effects either locally or constitutionally. One case of bronchiectasis in a human being has been treated. This was a very severe type, secondary to an aspirated foreign body. A persisting cough made it difficult to retain the fluid in the diseased area so no improvement was attained. One wonders though, if the technic were perfected would it not be possible to secure improvement in properly selected cases? It is of course realized that much experimental work remains to be done in this field.

Summary

Three physical methods have been used in connection with bronchoscopy. First, electrodesiccation and coagulation; second, ultraviolet radiation in the bronchi; and third, ionization to soften scar tissue. Ionization is suggested in small chronic lung suppurative processes.

Discussion

Dr. Lewis J. Silvers (New York City): I would like to ask Dr. Kernan if he has tried using mild coagulation on the fibrostenotic bronchus prior to the use of iontophoresis?

Dr. John Kernan (closing): In reply to Dr. Silvers' question: No, I have not tried that, but thank you very much for the suggestion. It may be of great help to me and I am glad you raised that question.

ARCHIVES of PHYSICAL THERAPY
OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

.·. EDITORIALS .·.

PAPER EXPERTS ON PHYSICAL THERAPY

Time was, and not long ago, that secrecy in pharmacotherapy was considered essential for success. Prescriptions were written in Latin and the dosage and directions given in symbols all of which were a closed book to the laity. The more mysterious and illegible a prescription looked the more it was assumed to contain healing powers. But the times have changed. In keeping with the general trend of responding to the demand for information on all sorts of events and problems, medicine, too, had to fall into step and allow the people an insight into the nature of diseases, their prevention and management. Whether this popularization of the healing art is good or bad, is moot. Certain it is that not a few readers of the "health columns" in the daily press or of popular "medical advisers" feel themselves qualified to diagnose and treat all ills human flesh is heir to, except those which require major surgical operation.

With the scientific advances in physical medicine and the multiplicity of physical measures especially in the wide field of radiation it certainly was deemed proper to convey to the laity some idea of the value of modern physical therapy. The press, to cite one example, published from time to time some information culled from the transactions of scientific periodicals and often from the American Congress of Physical Therapy. The latter, as a rule, were controlled by a committee appointed to guard against any attempt at dramatization, overstatement or misinformation. Of late there appeared a few syndicated articles in the daily press written by physicians employed for such purpose, which contained half digested truths or implications likely to do more harm than good.

During the present month appeared in many newspapers such a syndicated article under the heading: "Physical Therapy." It is for the purpose of inviting the attention of such and other writers on medical subjects for nontechnical periodicals to the great need of being exact and careful in what is being stated that this comment is presented. In the past few days our attention has been directed to many queries for detailed information how to begin the practice of physical therapy without study or preparation because they gained the impression from the article under discussion that any one wishing to escape manual or other labor can find a lucrative career in this field.

This unfortunate example of no doubt well intentioned information appears over the signature of a regular physician, nationally respected for his sincerity and lucidity and because of his momentary abstraction which paradoxically is in behalf of physical therapy, we quote below part of his thesis in order to demonstrate the inherent dangers.

The first half of the syndicated article deservedly chides our contemporary medical schools for withholding valuable information from its students about the physiologic effects of physical measures, and the medical profession for failure to use them as widely as they deserve. So far well and good. But the article then continues:

> As a matter of fact, all that is necessary to become a skilled technician or operator in physical therapy is to know how to use or apply heat, massage and exercise. One need not be a physician because most physical therapists work under the direction or prescription of the patient's physician.

If more physicians would investigate physical therapy and make more use of it, it would mean much to the happiness and comfort of cases of fractures in or near joints and cases of arthritis, thus preventing the permanent stiffness that so often occurs in these cases.

Heat, exercise and massage, persistently applied, can work what appear to be miracles in some apparently hopeless cases. Heat, increased circulation, movement is the foundation of physical therapy. Electricity and X-rays might be called the superstructure.*

As a general proposition we are in accord with the idea of promulgating knowledge to the masses in order to acquaint them with the possibilities and benefits to be derived from the scientific application of physical therapy as well as with its limitations. This branch of medicine is in no need of exaggerated claims for unusual efficiency, because it rests on a scientific basis and has definite indications and contraindications in the management of disease which laymen can hardly evaluate and control without competent medical supervision. So-called miraculous cures have occurred in many instances deemed hopeless even without any treatment, but to ascribe such alleged virtues to any branch of medicine is a direct contradiction of the meaning of science.

Again, in the article under discussion, the need for supervision by one who has specialized in physical medicine is not sufficiently stressed, as a result of which there is created in the minds of laymen and laywomen a wholly erroneous impression. The need for proper supervision is best illustrated by comparing the problem with the following situation. All physicians are agreed that sulfanilamide is a potent drug offering great possibilities for good in the management of certain grave infections. The same holds good for insulin, sera and certain alkaloids in indicated conditions. With the knowledge of their potency and even dramatic possibilities conveyed to the laity, would it be justifiable to allow the impression to go forth that any person can go to the nearest counter to purchase these remedies and use them under the guidance of a pharmaceutical apprentice? If the good doctor-author should raise the issue that physical measures cannot be compared with the examples just given, we would respectfully enlighten him to the effect that virtually all are sufficiently potent in their physiologic effects to become dangerous in the hands of untrained personnel such as associated with housewife or chambermaid ministrations. Why, we ask, has the American Medical Association felt impelled energetically to combat the influx of twilight healers, bathroom rubbers, and graduates of diploma mills, not to mention the vast number of pseudo-Hippocrateans endeavoring to enter the field of medicine and particularly that of physical therapy by the back door? While acknowledging their good intentions and the good popularization of medical problems can achieve, we must guard against certain shortcomings which unintentionally may bring about the opposite result.

Syndicated articles would best serve the greater good if they emphasize that physical therapeutists must first be qualified physicians and surgeons of considerable experience before they can prepare themselves to become specialists in physical medicine. So far as their technicians are concerned, their role and function correspond to those of graduate nurses in other fields and no more. And just as no ethical and conscientious nurse will care to assume the role of an independent practitioner but will content herself with strictly carrying out the instructions given her by her medical employers, so no technician can carry out any form of treatment beyond the specific directions prescribed by physicians qualified as physical therapeutists, as otherwise the doors would be opened wide to medical anarchy with resultant incalculable injury to innocent sufferers.

Even a technician must have a good grounding in the elementals of anatomy and physiology and undergo a proper course of training in order correctly to carry out his or her task. In contrast to the impression conveyed in the well-

* *Chicago Daily News*, October 9, 1940.

intentioned but improperly presented article above alluded to, heat does not mean the application of a simple hot water bag or electrically heated pad but the use of complicated apparatus which cannot be operated by merely turning on and off a switch. Massage is a highly developed art which must be applied with extreme care in pathologic conditions. The average "rubber" is as far from being a scientific masseur as a blacksmith is from a violin virtuoso. The art and science of exercise as applied for therapeutic purposes is more complicated and difficult to learn and apply than pharmacotherapy. For this and similar reasons it is hoped that writers and educators on medical subjects will present any and all problems of physical therapy in the proper light and thereby they render greater service to all concerned.

IMPORTANT COURT RULING ON ELECTROSURGERY

Elsewhere in this issue* appears a news item about the sentencing of a cultist to the penitentiary for the illegal practice of electrosurgery which merits more than passing notice. It appears that a naturopath named Nethken appealed to the Supreme Court of Arizona from a sentence of a lower court and that this highest tribunal confirmed the sentence on the evidence. The defendant had apparently fulgurated a growth on the sole of a foot which he had diagnosed as cancer. Without here entering into the rather puerile defense that the medical practice act was not properly worded so that under it any one could practice without a license, the Supreme Court weighed the actual facts. While naturopaths like similar cultists are licensed to practice drugless therapy, which unfortunately includes also physical measures, they are forbidden to resort to surgery. Evidently the defendant possessed a diathermy apparatus which he was entitled to utilize for purely medical purposes, but it was shown that he deliberately produced a burn or cauterization of the growth by holding a metal electrode a short distance from the "target." The Court held that this was not an accidental burn but one deliberately brought about, and this constituted a surgical operation legitimately employed by surgeons for the destruction of malignant growths.

This decision at once accords electrosurgical procedures the status of classic surgical methods, a decision in keeping with the concepts accepted by the medical profession.

The moral of this decision is obvious. When electrosurgery was made possible by the introduction of suitable apparatus certain salesmen convinced not a few physicians engaged in general practice that if they purchased an apparatus and a few electrodes they could perform any and all surgical operations with ease and safety. The result has been disaster fortunately in a few instances. The ARCHIVES on several occasions has brought articles exposing the falsity of the claim that an apparatus and a circular of instruction sufficed to enable one without especial training in operative medicine to undertake even comparatively minor operations. By this time the profession is thoroughly familiar with the conditions involved in the practice of any form of surgery, classic or electrical. The situation is different with such luminaries in the dark field of pseudo-medicine as naturopaths, naprapaths, chiropractics and all their genus. It was bad enough for legislatures in many states to open to men and women untrained even in the rudiments of the medical sciences the gates to a field where they can gather sick sheep for their phantastic ministrations. But to allow them to utilize such methods in physical therapy which require particular skill in their application was folly supreme. The inevitable result was that many even went beyond their legal-

* See news item on page 630.

ized field as happened in the case in Arizona. There the woman patient had the courage to bring the offender to justice, but others have escaped such a fate because there were no complainants.

It is clear that while electrosurgery will in future enjoy the protection of the law, physical therapy continues to be a stepchild any one feels privileged to abuse. The Congress (and especially organized medicine) has done a good deal to bring this situation to the attention of legislative bodies, but it will take much time and effort before one can hope to secure the legal recognition of physical therapy as a branch of medical science which requires and justifies the same control as is prescribed for pharmacotherapy or surgery. In the light of certain known tendencies of a political nature, the task may appear almost insurmountable; but obstacles have been made to be overcome, and all interested in the scientific advancement of physical therapy must support the Congress and the ARCHIVES in their efforts to overcome ignorance and avarice for the protection of the patient and our profession.

Arthritis — Cecil

(*Continued from page 584*)

to consider the condition and the age of the patient, and the duration of the disease. All of these have a bearing on the kind of treatment we will employ. Certainly sooner or later every case has to have physical therapy, and as Dr. Currence said, during convalescence physical therapy is perhaps the most important part of the management.

Climatologic Influence on Blood Sugar — Cronheim

(*Continued from page 601*)

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18. ————: Effect of Ultraviolet and Visible Rays on Carbohydrate Metabolism, Arch. Phys. Therapy **18**:750 (Dec.) 1937.

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SCIENCE, NEWS, COMMENTS

Full Professorship to Dr. Polmer

It is pleasure to announce that our President, Dr. Nathan H. Polmer has been promoted to full Professor of Physical Therapy at the Louisiana State University Medical Department. His many friends congratulate him on this honor, a distinction which to date is only enjoyed by him alone in undergraduate medical education.

Mr. Howard A. Carter Awarded Honor

Mr. Howard A. Carter, Secretary of the Council on Physical Therapy of the American Medical Association was presented with the First Award for the "greatest value to medicine in the field of Otolaryngology" for his exhibit at the Annual Session of the American Academy of Ophthalmology and Otolaryngology in Cleveland, October 7-11, 1940.

Correction Re: Dr. Kovács

Inadvertently the name of Dr. Richard Kovacs of New York was omitted from the list of officers elected at the convention of the Congress held last month in Cleveland. Dr. Kovacs was elected Secretary of the Congress to succeed himself. We embrace the opportunity of this correction to felicitate him on the well earned recognition of his services rendered the Congress during his preceding terms of office.

National Research Council Committee on Physical Therapy

The National Research Council of Washington, D. C., is cooperating with the Army in an advisory capacity regarding various departmental activities of medicine and surgery. One of the subcommittees under Surgery is Orthopedics and the Chairman of this Committee, Dr. George E. Bennett, of Baltimore, has appointed a Physical Therapy Subcommittee. The following are members:

J. S. Coulter, M.D., Chairman,
Northwestern University Medical School.
Frank H. Ewerhardt, M.D.,
Washington University Medical School.
K. G. Hansson, M.D.,
Cornell University Medical School.
Frank H. Krusen, M.D.,
Mayo Clinic.
Walter J. Zeiter, M.D.,
Cleveland Clinic.

Winner of the 1940 Mississippi Valley Medical Society Contest Announced

The third annual Essay Contest of the Mississippi Valley Medical Society "for the best unpublished essay on a subject of practical and applicable value to the general practitioner of medicine" has been awarded (first prize) to John F. Casey, M.D., of Boston; (second prize) to F. Stanley Morest, M.D., of Kansas City, Mo., and (third prize) to Charles W. Pavey, M.D., of Columbus, Ohio. The winner of the first prize receives $100.00 cash, a gold medal, a certificate award, and an invitation to present his essay before the annual meeting of the Mississippi Valley Medical Society. Certificates of merit will be given to Drs. Morest and Pavey.

New York Physical Therapy Society

The New York Physical Therapy Society will hold its regular October meeting Wednesday, October 9th, 1940, at 8:15 P. M., at the New York Academy of Medicine Building, Fifth Avenue, at 103rd Street, New York, N. Y.

The following program is planned:

I. Scientific Session — 1. The Use of Steam Jets, Ultraviolet and Diathermy in the Treament of Infections. — *Jerome Weiss*, M.D., and *Hans J. Behrend*, M.D.

2. The Use of Physically Induced Pyrexia and Chemotherapy in the Treatment of Subacute Bacterial Endocarditis. — *William Bierman*, M.D.

3. Physical Measures in Common Infections, Furuncles, Carbuncles, Erysipelas, Osteomyelitis, Wound Infections, Poliomyelitis, Septicaemias, Respiratory Infections, etc. — Case reports — Lantern slides, etc. General Discussion by members and guests. All Physicians are welcomed.

II. Executive Session — Reports from the Annual Meeting of the American Congress of Physical Therapy. Physical Medicine and Medical Preparedness, etc.

Lewis J. Silvers, M.D., President,
64 East 87th Street, New York, N. Y.
Madge C. L. McGuinness, M.D., Secretary,
1211 Madison Avenue, New York, N. Y.

Pore Patterns by Electrophoresis

A technic of mapping "pore patterns" for the entire body which can be used in analyzing structural and physiological changes in diseases of the skin was announced at Ann Arbor, Mich., June 6, by Drs. Harold A. Abramson, assistant professor of physiology in the Columbia University School of Medicine, and Manuel H. Gorin of Mount Sinai Hospital, New York City, at the 17th National Colloid Symposium of the American Chemical Society, at the University of Michigan. Important variations in the distribution of the pores of the skin already have been noted, especially in the fingers, it was declared. The phenomena depend upon the forcing of dyestuffs into the skin with an electric current and observing into which of the various pore-like parts of the skin the dye entered. It was found that the sweat glands are the main channels for the formation by electric current of "liquid

bridges" — unbroken columns of liquid which can carry large molecules from the outer surface of the skin to the regions containing blood capillaries.

Abramson and Gorin had previously shown that when a direct electric current is applied across the living human skin, the skin may be considered to act like a system of pores through which electrical transfer of substances like ragweed pollen extract may be achieved by electro-osmosis, in which a liquid moves through a porous diaphragm under a difference of electric potential.

"When a dye like methylene blue is introduced into the skin by an electric current, a pattern consisting of colored blue dots may be 'developed' by rubbing the skin vigorously to remove the most superficial layers which mask the pore pattern," the report said.

"Such pore patterns appearing as clusters of tiny colored dots on the skin, may persist for several weeks. During this time significant changes may be seen to take place in their appearance. Originally, they are solidly colored rings or dots up to one millimeter (about one twenty-fifth of an inch) in diameter. But after some time the dots may decolorize in the center leaving closed rings or doughnut forms. These doughnut forms are the cells comprising the walls of the sweat glands selectively stained by methylene blue.

"Similar patterns can be obtained with simple substances like copper sulfate which enters the pores and can be identified by precipitating copper ion as copper sulfide. Both positively and negatively charged dyes can be driven into the skin with an electric current. These phenomena serve further to emphasize the importance of the liquid bridge theory in determining the movement of materials through the skin.

"Several applications of the phenomena are being studied. One project consists of plotting the distribution of the electrically active pores over the entire body by this technic. Experiments of this kind are under way with Dr. Eric Ponder of the Biological Laboratory, Cold Springs Harbor, New York.

"The method may also be utilized to analyze structural and physiological changes in diseases of the skin. Thus, the pore patterns have been mapped for scar tissue, and for the skin diseases scleroderma, in which rigidity and hardness of the skin develops, and sporiasis, characterized by circumscribed red plaques covered with white scales. In this way, the characteristics and progress of these diseases may be defined."

The dye technic localizes explicitly the anatomical structures in which liquid bridges are produced when an electric field is set up across the surface of the skin, it was pointed out. Relatively little or no dye enters through the hair follicles or through the intact skin matrix which makes up the remaining structure. The sweat glands alone become "electrically responsive" and form channels for the transport of relatively large molecules like the active constituents of ragweed pollen which produce hay fever in allergic individuals.

Drs. Abramson and Gorin emphasized, however, that their research does not clarify the cause of hay fever nor even indicate how pollen is ordinarily received into the body, except perhaps in the case of exceedingly sensitive persons. It does provide a method for driving certain solids into the body without breaking the skin surface.

The channel works both ways, according to the current applied. Liquid from the outside is provided by wet cotton, in the experiments; from the inside by tissue fluids. The electric field simply accelerates the movement exemplified by the process of perspiring and forms liquid bridges on which the pollen is pushed from one side to the other.

Synthetic Cleansing Agents May Be Used Against Germs

Discovery of the germ-stopping power of modern synthetic cleansing agents — soaps and shampoos to the layman — may provide scientists with a new class of chemical weapons against disease, including tooth decay.

Experiments in this direction are now under way at the University of Chicago, Dr. Benjamin F. Miller and Dr. Zelma Baker report.

Three of the cleansing agents, with the trade names Damol, Emulsol-605 and Emulsol-606, are relatively non-poisonous and non-irritating to mice and rabbits, the Chicago scientists have discovered. They stop the growth of germs in the test tube. Their protective action towards experimentally induced germ diseases is now being investigated.

One of the cleansing compounds, Zephiran, is already under study as an anti-tooth decay weapon. The germ-killing power of this substance was announced by Prof. G. Domagk, of Germany, the man who gave sulfanilamide to the world. Tests of Zephiran by the Chicago scientists showed that it promises to fight tooth decay in two ways: 1, by killing germs; 2, by stopping production of lactic acid which, in high concentration, can destroy tooth enamel and thus give decay a chance to start.

The new cleansing agents were developed to meet various special demands of industry. More than 1,000 of them have been patented within the past decade. They have long, chemical names. Zephiran, for example, is alkyl dimethyl benzyl ammonium chloride. Another, with the trade name of a much advertised shampoo, is triethanolamine lauryl sulfate. One of them is sulfonated castor oil.

The killing power of some of these chemicals is effective against germs of both gram negative and gram positive groups. All germs belong to one or the other of these groups, depending on how they take a certain stain. Alkalinity and acidity can enhance or decrease the germ-stopping power of the cleansing agents. This depends on whether the cleanser is a cationic (electropositive) or anionic (electronegative) compound.—*Science News Letter.*

Females More Thrifty Even in Utilization of Iron

The characteristic difference between the prodigal male and the thrifty female holds good even for the way anemic bodies of the two sexes use iron for blood-building, latest scientific researches seem to show.

When an anemic female is fed only a tiny amount

of iron — a time when most economical use of the iron is of vital importance — she actually retains more iron than the male, in spite of her smaller body size. This and other facts showing a sex difference in utilization of iron were learned from studies made by Drs. Louise Otis and Margaret Cammack Smith, of the University of Arizona (*Science*, Feb. 9). The studies, to be sure, were made on male and female rats, but these small laboratory animals are much like humans in their nutritional requirements.

The rats had their iron reserve supply depleted by an exclusive milk diet. Then rats of both sexes were fed the same amount of iron. The females showed their thrift by their greater gain of hemoglobin (red coloring matter of the blood) and when the iron content of their bodies were determined, the amount of iron per gram of rat was always higher for females than for males fed the same amount of iron. — *Science News Letter.*

Vitamin Treatment Cures Blinding Eye Disease

Thousands now blind or threatened by blindness due to an eye disease, keratitis, will have a chance to regain or preserve their sight because of the discovery that riboflavin, one of the vitamins formerly lumped together under the label B, will both prevent and cure the disease.

This latest vitamin therapy discovery, made at the University of Georgia, is announced through the U. S. Public Health Service. (*Public Health Reports*, Jan. 26.)

Lack of riboflavin vitamin in the diet is proved to be the cause of the eye disease. In the first clinical trials, eleven patients were cured of the disease by doses of riboflavin, with improvement beginning within a few days.

Pathetic little babies born with syphilis, formerly thought to be a cause of the eye disease, can now have their eyes cured.

Discovery of the cause and cure of keratitis, which has long baffled ophthalmologists, was made by Drs. H. D. Kruse, of the Milbank Memorial Fund, New York, V. P. Sydenstricker, of the University of Georgia Medical School, W. H. Sebrell, of the U. S. Public Health Service, and H. M. Cleckley, of the University of Georgia Medical School. They also have found a way of detecting its earliest stages.

Keratitis is a disorder of the cornea of the eye. The cornea is a delicate tissue in front of the eye whose main function is the transmission of light. Ordinarily it has almost no blood vessels in it. In keratitis, however, more blood vessels grow into the cornea, and later white opaque spots appear. If these occur in the line of vision, eyesight is blurred. If the condition grows worse, blindness results. Itching, burning, and pain when light falls on the afflicted eye are among the symptoms of keratitis.

In the 11 patients, including two with syphilis, keratitis was cured by doses of riboflavin alone, Dr. Kruse and associates report. Improvement began within a few days. When the riboflavin treatment was stopped, the eye disorder returned. It was again promptly cured by more doses of the vitamin. Those whose vision had been badly impaired were able to see normally.

The two patients with syphilis, one congenital and one acquired, had been getting anti-sphilis treatment for months without any improvement of the eye trouble. The vitamin treatment alone, without simultaneous treatment of the syphilitic infection, brought about "remarkable improvement" of the eye condition.

While lack of riboflavin is now seen to be the cause of keratitis, the lack may be due to many factors besides poor diet, the doctors explained. Chief dietary sources of the vitamin are liver, milk, eggs and vegetables. Patients may fail to get enough of the vitamin either because they do not eat enough of these foods or because they cannot absorb the vitamin from the foods. Impaired digestion may interfere with the vitamin absorption. Infection, such as syphilis, may also make it impossible for the body to get enough of the vitamin from food.

Clue to the discovery of the vitamin cure came from an earlier discovery of Dr. Sebrell and Dr. R. E. Butler, U. S. Public Health Service. They found that many patients believed to be suffering from pellagra, Dixie's hard-times disease, were also suffering from another condition. Nicotinic acid cured their pellagra, but left the shiny, reddened lips, cracked mouth corners and fatty deposits around the nose untouched. This condition, they found, could be cured by the vitamin, riboflavin. It could even be induced by putting patients on a diet lacking only this vitamin. Before this, no one had known that human beings needed riboflavin in their systems.

Soon Dr. Sydenstricker discovered another sign of riboflavin deficiency or lack: inflammation of the tongue, with magenta-red color instead of the normal pink, or the scarlet of pellagra.

Next it was noticed that patients coming to the hospital with riboflavin deficiency (ariboflavinosis is its technical name) also had eye trouble which the doctors recognized as typical keratitis. Neither nicotinic acid nor any other vitamin cured this condition. Eye doctors had tried for years, unsuccessfully, to find a cure. But when the patients were given riboflavin for their sore mouths and tongues, their eyes also improved. Further trials — stopping the riboflavin and watching the eye trouble return, and the crucial trial of the vitamin in patients with syphilitic keratitis — convinced Dr. Kruse and his associates that riboflavin was the cure for this eye disorder.

Exact diagnosis and study of the eye disorder was made possible by examination with a slit-lamp, donated by the Milbank Memorial Fund. A pencil-point beam of light from the slit-lamp is directed across the eyes and the doctor looks into them through a microscope. This enables him to see the blood vessels and opaque spots in the cornea in keratitis. When the condition has been cured, tiny lines seen at this examination show where the blood vessels were. In the early stages of the disease this examination also shows them just beginning to appear. — *Science News Letter.*

Surface of Lung Is Equal to Land 31 Feet Square

The entire surface of a normal lung is equivalent in area to a strip of land occupied by a house 31 feet square, W. H. Lehmberg, American Optical Company scientist, has figured. In 24 hours of normal respiration approximately 600,000 cubic inches of air are breathed, the equivalent of air contained in a room 7 by 7 by 7 feet. — *Science News Letter.*

Medical Practice Acts: Surgical Diathermy by Naturopath Constitutes Unlawful Practice of Medicine

The defendant, a licensed naturopath, removed "a lump or growth," which he diagnosed as "cancer," from the bottom of Mrs. Larkin's right foot by cauterization with "a surgical diathermy" apparatus, an apparatus commonly used by surgeons. According to the defendant, "electricity . . . was turned on the target [presumably the growth on the patient's foot] through a copper wire connected with a diathermy machine and from one-half to an inch from the target" and the heat emanating therefrom on "the target" produced a burn about 1 inch (2.5 cm.) in diameter and about one-eighth inch (0.32 cm.) deep, which destroyed the growth. For the performance of this procedure the naturopath was convicted of practicing medicine without a license, in violation of the Arizona medical practice act, and was sentenced to the penitentiary. He then appealed to the Supreme Court of Arizona.

The naturopath contended that it is not a statutory offense in Arizona to practice medicine and surgery without a license so to do. Since every one at common law, he argued, could practice medicine or the healing art, it is not a crime so to practice without a license unless some particular statutory provision makes it so. The section of the Arizona medical practice art pertinent to this matter merely provides: "Any person who practices, or attempts to practice, without having a valid, recorded certificate, shall be guilty of a felony . . . " (Revised Code, 1928, section 2560, as amended, Laws, 1935, chapter 99, section 2). This, the naturopath contended, is inadequate to make it a statutory offense to practice medicine and surgery without a license. The Supreme Court, however, held that the provision in question did make it a statutory offense to practice medicine and surgery without a license. This provision is a part of a section of the medical practice act and, in the Revised Code, 1928, it appears under the title "Medicine and Surgery." Provisions corresponding to this particular section appeared in the Revised Statutes, 1913, under the title "Practice of Medicine" and expressly made it a misdemeanor for any person to practice "medicine or surgery" without being licensed so to do. The Revised Code, 1928, said the court, was the result of studies made by a code commissioner whom the legislature prior to 1928 directed to codify the then existing laws and expressly instructed not to make any change in existing laws, but only to harmonize where necessary, reduce in language and remove inconsistencies (Laws, 1925, chapter 35, section 3). The court, concluded therefore, that the omission of the words "medicine and surgery" following the prohibition against unlicensed practice in the section in question had been done merely to eliminate redundancy of language. The effect of the omission was not to exempt one from punishment who practices medicine without a license.

The court was next called on to determine whether or not the acts of the naturopath were within the scope of the license to practice naturopathy which he possessed. In the practice of naturopathy in Arizona, said the court, no medicine may be used and the treatment must be nonsurgical. The naturopathic practice act of Arizona (Laws, 1935, chapter 105) authorizes persons possessing the qualifications therein prescribed, when duly licensed by the board of naturopathic examiners, to practice naturopathy. Section 5 of that act reads:

> Naturopathy Defined. For the purpose of this Act, Naturopathy, which includes all forms of physiotherapy, is hereby defined to be: A system of treating the abnormalities of the human mind and body by the use of drugless and nonsurgical methods, and includes the use of physical, electrical, hygienic, and sanitary measures incident thereto.

This section permits a naturopath to use electricity in treating the human body and mind but prohibits him from performing surgical operations. His methods must be nonsurgical and drugless. The operation performed by the defendant was with an instrumentality in use by surgeons, and so it was conclusively surgical in its nature. If the defendant had used a scalpel to cut out the growth instead of burning it out, the act would have been no more surgical. While he had the right to use electrical heat in the practice of naturopathy, he had no right to use it to perform a surgical operation. There was nothing in the evidence to indicate that the defendant carelessly or mistakenly administered an overdose of heat or that he burned his patient by accident. On the contrary, the evidence showed that he intentionally and purposely applied the electricity to destroy the lump on the patient's foot by burning it out. He adopted the surgeon's method of curing cancer, the only one, said the court, that has been discovered to date.

For the reasons stated above, the judgment of conviction was affirmed.—*Nethken v. State (Ariz.), 104 P. (2d) 159.* — [J. A. M. A. **115**:1048 (Sept. 21) 1940.]

Dr. Mathew S. Hosmer 1856-1940

It is with deep regret we chronicle the passing of Dr. Mathew S. Hosmer, of Ashland, Wisconsin, on September 22, last. Dr. Hosmer has been an esteemed member of the Congress for nearly fifteen years, and has taken a deep interest in the advancement of scientific physical medicine. Our deceased fellow member was born in 1856 and received his doctorate degree from the University of Michigan Medical School in Ann Arbor in 1882, and settled in Ashland, Wisconsin in 1899, where he practiced the rest of his life, devoting himself to gynecology. The *Archives* and the Congress extend to his family heartfelt condolence.

BOOK REVIEWS

THE 1940 YEAR BOOK OF PHYSICAL THERAPY. Edited by *Richard Kovacs*, M.D., Professor and Director of Physical Therapy, New York Polyclinic Medical School and Hospital, etc., etc. Cloth. Pp. 464 with 149 illustrations. Price, $2.25. Chicago: The Year Book Publishers, 1940.

The 1940 Year Book of Physical Therapy lives up to the high plane set and since maintained by its editor. Even though this volume represents the third annual publication it has already become accepted as one of the most informative and important of the series of clinical reviews instituted by American initiative some forty years ago and deservedly so captioned this year in honor of its founders, the brothers Head, Dr. Gustavus P., and Mr. Cloyd James, respectively. There are four reasons why this special year book merits attention. It presents 54 different physical methods and 61 new therapeutic suggestions that apply to at least 53 different disease conditions. Furthermore, the editor has prepared an original article on physical therapy in chronic arthritis that presents personal observations and guidance of great value to clinicians. The subjects included (283) represent timeliness in the methods of treatment employed by the most capable of students, culled from the recent literature. Comprehensiveness of text because it was selected out of 1,000 contributions in 88 periodicals suggests not only meticulous editorial supervision but also, and what is of greater importance, a rich literary harvest of practical value to the physician. Last but certainly not least of the reasons that impel the reviewer enthusiastically to endorse this publication are the numerous concise and incisive comments by the editor, which guide the reader to a clearer understanding of the abstracted papers incorporated in the book. Accordingly this 1940 Year Book is sincerely recommended as one of the most valuable of books for clinicians and technicians, for it is certain to become one of the best thumbed texts in this popular series of annual American clinical reviews.

DIFFERENTIAL DIAGNOSIS IN INTERNAL MEDICINE. By Prof. Dr. med. *O. Naegeli*, Late Director of the University Clinic of Zurich, Switzerland. Authorized Translation by *Simon B. Spilberg*, M.D., Head of the Department of Internal Medicine, Mount Sinai Hospital, Milwaukee, Wisconsin. Cloth. Pp. 726 with 162 illustrations. Price: $10.00. Chicago: S. B. Debour, Publishers. 1940.

The present book is the last the eminent Swiss clinician wrote before his recent death. For many years his medical clinic of the University of Zurich has been a Mecca for physicians who were desirous of perfecting themselves in the diagnostics of internal diseases. His writings being mostly in his native tongue were known to comparatively few Americans and Britishers, so that the present excellent translation must be regarded as a most valuable contribution to the diagnosis of internal diseases.

The text proper is that of a special monograph rather than of a textbook. It is intended for experienced physicians who have not only a good grasp of clinical medicine but are either familiar with the laboratory methods essential as aids in diagnosis or have such facilities at their disposal. While Naegeli stresses the value of hematologic studies, he by no means underrates the importance of a properly taken anamnesis and the evaluation of leading symptoms for differential diagnostic purposes. Careful perusal of the book clearly reveals the author's endeavor to present by word and illustration the methods used in his clinics for many years which he taught to many advanced clinicians as well as his regular classes. As a matter of fact he shows in the very first chapter how a principal symptom is to be the starting point for further study in obscure or complicated conditions in order to arrive at a correct diagnosis, a feature which runs like a golden thread throughout the entire work. Beginning in the second chapter with the differential diagnosis of polycythemia and plyglobulia, he continues with the hemorrhagic diatheses, the leukemias, diseases of the lymph glands, the myelopathies and the Mikulicz syndrome. This part covers ten well rounded chapters. The subsequent chapters, of which the book has twenty-seven with many subdivisions, are devoted to the anginas with especial reference to granulocytopenia, diseases of the spleen, the biliary apparatus, the abdomen, appendicitis (a particularly well presented subject), peritonitis, abdominal effusions, diseases of the intestines, methods to determine pancreatic affections, pulmonary and pleural diseases, each subject being treated with frankness based on actual experiences not excluding errors committed and their eventual detection. Furthermore, the most exacting studies pertain to a large variety of febrile diseases, and in the reviewer's opinion here Naegeli rises to great heights. Of equal interest are the chapters devoted to diseases of the joints, blood vessels, kidneys, the nervous system, the circulatory apparatus and of the endocrine system.

Here is a master clinician who undertook to guide serious-minded practitioners through the maze of symptoms and clinical findings by all available tests to their interpretations along systematic groupings running like the thread of Ariadne. Indeed, the book is the testament of a great mind, which leaves incalculable treasures in the field of differential diagnosis. It is for this reason that the scholarly translator has earned the thanks of the profession. The publisher merits deep appreciation for the undertaking involved in a format in keeping with the dignity and worth of this great work.

A TEXTBOOK OF SURGERY BY AMERICAN AUTHORS. Edited by *Frederick Christopher*, B.S., M.D., F.A.C.S., Associate Professor of Surgery at Northwestern University Medical School, Chief Surgeon, Evanston (Illinois) Hospital. Second Edition. Cloth. Pp. 1693 with 1381 illustrations. Price, $10.00. Philadelphia and London: W. B. Saunders Company, 1939.

The second edition of this excellent text is presented under the collaboration of nearly two-hundred distinguished American authorities in the surgical and allied fields. Each has contributed an important and cogent exposition on one of the numerous facets related to the broad study of surgery, drawn from wide clinical experience and unusual teaching facilities afforded at the respective American medical centers with which their names are associated. This suggests an interesting corollary; namely, that since the opinions expressed in these voluminous pages have been evolved from personal experience and domestic research, such an all-American text should negate the erroneous impression of the major dependence of American surgical practice and instruction upon those of foreign inspiration. Without any intended chauvinism one may indicate one's pride in a contribution that is so replete with rounded expositions by recognized authorities of American extraction as to have been acclaimed by reviewers, teachers, students and surgeons.

The second edition has been materially revised and brought down to date. The deaths of certain contributors necessitated revision of certain chapters by others, which was carried out in a manner that reflects great credit on all concerned. Thus Howard K. Gray of the Mayo Clinic revised the section on the gallbladder and ducts, written by Judd and his collaborators; wounds of the chest written by Conners, was revised by William F. Reinhoff, Jr., of Johns Hopkins; duodenal ulcer written by Klopp was revised by John J. Morton, of the University of Rochester, to cite but a few examples of the major literary labors that entered into the revision of this new text. Interesting to record are also several new sections such as the ones prepared by Hayes E. Martin on cancer of the lip and tongue, and those written by Ladd, Meleney, Curtis and others which lack of space forbids to name. Twelve authors discuss the use of sulfanilamide. Other chapters include the latest views on surgical procedures of every important division of the living human, including such topics as protruded and injured intravertebral disks; the Brook treatment of fractures of the patella by excision, and the Henry midline extraperitoneal operation for femoral hernia. That the text has kept apace with the latest advances is indicated by such discussions as the surgical treatment of actinomycosis, the value of sterols (Vitamin K) to jaundiced patients, the use of mandelic acid and sulfanilamide as urinary antiseptics and urinary protein in testicular tumors. Physical therapy is ably discussed by Coulter in relation to fractures. Altogether this impressive text is an encyclopedic exposition of the latest and classic contributions to surgery and deserves warmest recommendations.

SPECIAL NUMBER ON DIABETES. "The Antiseptic." Edited by *U. Rama Rau*, M.L.C. and *U. Krishna Rau*, M.B., B.S. Paper. Vol. 37: 441-624 (June) 1940. Calcutta.

The entire June issue of "The Antiseptic," the noted medical periodical of India, is devoted to a thorough evaluation of the problem of diabetes in all its manifestations. Drs. U. Rama and U. Krishna Rau, the editors, are to be felicitated on this monographic endeavor and its success. They have collected in this special number a group of 34 collaborators who present the various views regarding the historic background and development of the diabetic problem in its multiple phases and complications. The discussions include such a wide terrain as the management of diabetes and its control in rural practice; remedies associated with insulin therapy; non-surgical emergencies and surgical intervention; sepsis in diabetics; and certain situations arising wherein specialistic therapy is essential as instanced in complications associated with pregnancy, tuberculosis, obesity, eye, ear, nose and throat and the like. This issue is of particular value to all English reading physicians.

INTERNATIONAL ABSTRACTS

Artificial Fever Therapy. Leland F. Glaser.

J. Kansas M. Soc. **41**:192 (May) 1940.

Up to the present time, 192 patients have received a total of 1069 fever treatments in the cabinet, and 171 patients have received a total of 1407 fever baths.

Chronic gonorrheal infections, atrophic arthritis, acute and chronic eye infections, syphilitic keratitis and Sydenham's chorea were improved in 60 to 80 per cent of the patients. Other disease, showing less benefit from fever therapy include parenchymatous keratitis, multiple sclerosis, scleroderma, tabes dorsalis, meningovascular syphilis, syphilitic optic atrophy, impetigo, undulant fever, tertiary syphilis of the skin, and tuberculosis of the skin. Acute gonorrheal infections are much more satisfactorily treated by sulphapyridine. One recent case of chronic gonococcic arthritis was refractory to sulphanilamide, but later responded with symptomatic relief to prolonged sessions of fever. The results obtained by the fever bath roughly parallel those obtained with the cabinet. Chronic gonorrheal infections will only respond to high fever sustained for a time equal to the lethal dose of the bacteria. Nonspecific types of arthritis respond equally well whether treated in the cabinet or the bath. Very little symptomatic relief was noted by fever in lipoid nephrosis, bronchial asthma, and hypertension. There were no deaths from either method of fever therapy.

Office Treatment of the Pathologic Cervix. Sophia J. Kleegman.

Am. J. Surg. **48**:204 (April) 1940.

There is a small group of cases with endocervicitis in which electrocoagulation and conization give results superior to the nasal tip cauterization, particularly when there is a small external os, with a ballooned out chronically infected endocervical beyond it.

For electrocoagulation Ende has devised a good electrode and Cherry produced a modification of it. One disadvantage of the Cherry electrode is that because of the placement of the metal strips, raw surfaces are left in apposition and the possibility of subsequent stenosis is increased. After the canal is cleansed, dried and anesthetized the electrode is inserted into the canal, pressed against the wall and the current turned on for the required dosage. The handle is gradually rotated until a coagulation of half the canal is obtained, 2 mm. in depth. Ende recommends that a gauze soaked in ensymol be left in the canal for forty-eight hours after this procedure. The other half of the canal is treated eight weeks later. When necessary, treatment may be repeated at eight week intervals. For erosions and cysts, the bipolar electrode is used, and the superficial tissue between the tips is coagulated.

For electrocoagulation of cervical erosions and endocervicitis in the late puerperium, Barrett prefers the radio tube machine with a ball tip electrode causing electrocoagulation of the eroded area. Workers using this method have corroborated his excellent results. In a small series of extensive erosions of both lips, one lip was treated with the nasal tip cautery and the other lip with Barrett's method and healing took place the same in both lips as to time and degree.

Hyams devised a conization technic by which the infected glandular tissue in endocervicitis can be quickly excised, analogous to the Sturmdorf operation both as to tissue removed and degree of healing obtained. By his electrode with a fast cutting current, Hyams cones out the mucous lining of the cervical canal and its glands without injury to the underlying musculature. It is an office procedure and when properly done, as simple for the patient as any of the others.

Vacuum Massage of Eyeball. Theodore J. Dimitry.

Arch. Ophth. **23**:926 (May) 1940.

From early times ocular massage has been recognized as producing a favorable effect on diseases of the eye. Grecian records show such a procedure to have been practiced among that people, and Paul of Aegina, the last of the eclectics, commented on its curative value. Massage of the eyes seems not to have originated with the intellectuals, for the savages of Africa and America used it intuitively.

Pagenstecher in 1871, published a monograph on massage of the eyes, at which time he reported having obtained "magnificent results" by massage even when other agents failed. Donders in 1872, recited his accomplishments with ocular massage before the International Congress of Ophthalmology at London. Heiberg in 1874, Just, Pedraglia in 1880 and Damalix in 1881 particularized special disease benefited by massage. Hoffmann is credited by Domec with being the first to design an instrument for mechanically massaging the eye.

According to Dimitry, ocular massage is unquestionably of merit in the treatment of pathologic conditions of the eye, and its employment is simplified by the use of the simple instrument described.

Work Done by Muscles in Running. Herbert Elftman.

Am. J. Physiol. **129**:672 (June 1) 1940.

The resultant moments of force of the muscles acting about the joints of the limbs, and the rates at which they do work, have been determined for a running step. The energy requirement arrived at in this way represents a minimum for the step concerned; it does not include energy used for the

maintenance of tension in muscles which are not changing in length or for the duplication involved in the simultaneous action of antagonists.

The limb muscles did work at the rate of 2.61 h.p. If all the muscles in the body were included, and no energy was lost through friction, the rate would be at least 2.89 h.p. This confirms the value of 2.95 h.p. calculated by Fenn from the changes in potential and kinetic energy.

The work done by the limb muscles was divided as follows: Against wind resistance, 0.15 h.p.; fluctuations in total energy of the body, 1.37 h.p.; distribution of energy between the parts of the body, 1.09 h.p.

If only one-joint muscles were present, additional work at the rate of 1.36 h.p. would be necessary. The saving of this amount by two-joint muscles illustrates the importance of the disposition of muscles in determining muscular work.

Clinical Experience in Electrically Induced Convulsions. Francis E. Fox.

Brit. M. J. 4141:807 (May 18) 1940.

The results of electrically induced convulsions were entirely satisfactory even though the cases were specially selected for treatment. Except for the period of the "freeze-up" when it became impossible to transport patients to the institute, all have been treated with three shocks a week. The fact that shocks were administered three times weekly may be of some importance, since other groups of cases which received only two shocks a week have not fared so well. When shocks were given only twice a week one got a definite impression of unsatisfactory results.

The great advantages of electrical shock over other forms of convulsion therapy are: (1) The patient suffers no unpleasant memories. (2) The loss of consciousness is instantaneous as soon as the lever is pressed. (3) The possibility of fractures seems to be remote, provided certain precautions are taken. The precautions are: (a) A suitable resilient gag is placed between the teeth after any dentures have been removed. The best article is a rugger ring, such as is sold at dog requisites shops; this keeps the tongue away from the teeth, and also has a certain amount of "give" during the tonic stage of the convulsion. (b) The patient should be lying flat on the back, so that the possibility of a compression fracture of the bodies of the vertebrae is lessened. It was found that a resistive patient often would not lie flat after the insulated electrodes had been placed around the forehead. To overcome this a small non-convulsive shock was administered which made it possible for the patient to be straightened out and the gag placed in position, when the major shock was given. (4) The willingness of the patient to cooperate in this form of treatment after the first two or three shocks. (5) The celerity of the treatment. The patient can be treated in his everyday apparel, provided any constricting clothes are loosened around the neck and chest and the footwear is removed. (6) The appetite is definitely stimulated and the body weight rapidly increased. (7) The chronic constipation associated with these types of psychosis disappears early in the treatment. (8) The portability of the complete apparatus. (9) The manipulator need not be a highly qualified electrical technician.

Although the ultimate prognosis of this form of treatment is problematical at the present time, there seems no reason why the remission should not be prolonged indefinitely by "maintenance" shocks of about three in a single week, if the patient is found to be relapsing. Fox feels certain that patients would submit to this treatment far more readily than they would undergo the terrors of cardiazol or insulin. Moreover, this could be undertaken in their own homes, provided suitable electricity were available. The contraindications to shock treatment would seem to be arterial and cardiac diseases, high blood pressure, and intracranial diseases.

Convalescent Care — A Perpetual Challenge. E. H. L. Corwin.

New York State J. Med. 40:513 (April 1) 1940.

Institutional convalescent care is a recognized complement to hospital care under existing conditions of our modern city life. It is because of this recognition that New York City has 58 convalescent homes with a bed capacity of 4,040. All of them, as well as the Speedwell units which provide foster homes for children, are maintained by voluntary effort. Aside from a day camp for convalescent patients opened on July 10 of last year, the above named municipality does not maintain a single convalescent institution. It contributed, however, about $350,000 annually toward the maintenance of needy patients. By insisting that certain minimum requirements be met by the convalescent homes before they can qualify for the city subsidies, the City Department of Hospitals has helped to raise the standards of convalescent care and has set a precedent to be followed by the several community agencies which annually raise funds for welfare work. One rule insisted upon by the New York City authorities calls attention to a characteristic example of the existing lack of coordination between the hospitals and the convalescent homes. The city will not pay for a patient unless he is admitted to a convalescent home within ten days after his discharge from the hospital.

Treatment of Nasal Sinus Infection by Ultra-Short Wave Diathermy. W. P. E. Paterson.

Canad. M. A. J. 42:454 (May) 1940.

In a series of 126 acute and sub-acute cases treated for sinus conditions over a period of three years, Paterson found 96 were improved and quite enthusiastic about the treatment, 22 were questionable as to results; and 8 definitely had no improvement or were worse.

Economically, it was found that patients were restored to their normal condition much more

quickly than with the other forms of treatment, and thus were saved additional expense.

Paterson always used short wave diathermy in conjunction with other treatments. Adequate drainage is most essential in any treatment of sinusitis, and, providing no spurs no deviations of the septum were present, this drainage can be provided by some form of ephedrin spray. Submucous resection or removal of any obstruction to breathing should be done where indicated. Short wave diathermy was administered in conjunction with irrigation and lavage.

Short Wave Therapy in Eye Diseases. Frank W. Law.

Brit. M. J. **3**:122 (July) 1940.

From the experience of a growing body of ophthalmic surgeons and from the recorded results of those who have made a special study of the subject, it is concluded that diathermy plays an important part in the treatment of certain diseases of the eyes. The best results appear to be obtained from a short wave apparatus emitting a wavelength between 12 and 20 meters. Using the induction cable, a coil is placed in position on the patient's face so that the eye lies at its center; four thicknesses of Turkish toweling intervene between it and the skin, in order to absorb any moisture that may be produced as a result of local sweating.

The class of case which responds well to short wave treatment is the same as that which experience has shown to be favorably affected by the older long wave therapy. In the forefront is acute and subacute glaucoma, which are usually relieved of pain in a dramatic manner, and the tension often falling to reasonable levels, at least temporarily. Other classical methods of reducing tension in primary acute glaucoma, such as eserine in the form of drops, should be applied simultaneously. There is no justification for the experimental omission of such aids.

Acute inflammatory disease of the eye and its adnexa is benefited by diathermy. Into this category fall iritis and iridocylitis, interstitial keratitis, and orbital cellulitis. The results from the treatment of superficial inflammation such as conjunctivitis and scleritis have been disappointing. Choroiditis does not appear to be much affected, though the author's experience leads him to believe that diathermy is useful in the later stages, especially in the clearing of the consequent vitreous opacities. The treatment has a markedly beneficial effect upon the recurrent ulceration caused by the late effects of mustard gas in the eye.

Diathermy in Arthritis. Edward J. Burnett.

M. Bull. Vet. Admin. **17**:23 (July) 1940.

Diathermy seems to cause local active hyperemia, promoting an influx of arterial blood with its nutritional value. It tends to increase the leucocytes, of which the phagocytes may play some part. With this in mind, and having classified the type of arthritis a decision as to whether diathermy or some other current is to be used must be made. In the atrophic type of arthritis the joint does not receive the sudden onrush of heat, hence the aggravation of this type by diathermy. The galvanic current, because it is sedative and relieves pain, is preferable in such cases.

The large number of arthritic patients at the Veterans' Administration Facility, Los Angeles, receive physical therapy and associated drug and dietetic treatment. They state that their pain is not only relieved but that the joints are decidedly improved. Added to diathermy, the use of a mild surging galvanism is beneficial. In many instances, when treating a bed patient, the addition of a mild hand massage or a surging galvanic massage to the adjacent tendons and muscular structures was found advantageous.

Diathermy is a decided asset when used in conjunction with other medication, in the treatment of hypertrophic arthritis. In the atrophic type, diathermy is useless, and galvanism must be used. It is therefore necessary properly to classify all cases of arthritis. When this is done, intelligent selection may be made on the proper treatment, with likelihood of more satisfactory results, and with the assurance that the use of narcotics will be greatly curtailed. Approximately 6,000 treatments are given in the physiotherapy unit of Veterans' Administration Facility, Los Angeles, and therefore Burnett's conclusions are drawn from sufficient experience.

Use of Histamine in Rheumatoid Arthritis. R. O. Meuther.

Ann. Int. Med. **13**:2147 (May) 1940.

Meuther's experience with histamine includes administration by ointment, subcutaneous injection, and iontophoresis. He administered the drug by iontophoresis and succeeded in getting general reactions such as fall in blood pressure, flushing, palpitation. This method was time-consuming and difficult to continue after the patient left the hospital. He then used histamine ointment alone, mixed with a rubefacient such as capsicum, and also combined with various forms of salicylates. None of these ointments produced either general or local response of sufficient degree to be helpful, and recent experiences with commercial preparations of histamine ointment have been no better. He then resorted to subcutaneous injections of histamine with the following results:

Histamine diphosphate dilution (1-1000), when properly given to individuals without complete ankylosis of the joints, increased motility and frequently relieved pain. The subcutaneous administration of the drug seems to be as satisfactory as iontophoresis and is far superior to the use of the ointment. Though not a cure for arthritis, it is a satisfactory adjunct to other forms of therapy and, as such, may be expected to aid in some cases and to fail in others. When such failures are encountered, the drug should

be immediately discontinued. It should be administered cautiously to avoid severe reactions. No shock has been encountered nor any cumulative or deleterious effect. There was no alteration in blood chemistry, blood pressure, red blood cell count, and the like, from the levels determined at the onset of therapy. Treatment can be given over a long time because no tolerance is developed. Histamine, although not having a specific therapeutic effect in rheumatoid arthritis, when given subcutaneously does seem to be of value in the symptomatic treatment of the disease. It apparently enhances the value of other forms of therapy and, in many instances, enables the patient to carry on activities which would otherwise be impossible.

Electrically Induced Convulsions. F. Golla; W. Grey Walter, and G. W. T. H. Fleming.

Proc. Roy. Soc. Med. **33**:261 (March) 1940.

A maximal electrical stimulus may be applied to a peripheral nerve many thousand times without doing any harm or causing any irreversible change. In this case each stimulus need be only a millisecond or so in duration and the intensity of the current required to elicit a maximal response is only a fraction of a milliampere. When we come to stimulate the brain the conditions are different, partly because the efficiency of any electrode is bound to be less than when a peripheral nerve is stimulated owing to the less favorable anatomic orientation of the excitable cerebral structures.

As regards the stimulus itself, there are three variables which should be considered: frequency, wave form, and duration. The current used by Cerletti and Bini for reasons of convenience is a 50-cycle alternating current from the mains, and this choice is entirely to be commended since it greatly simplifies the design of the apparatus. The wave form, of course, is sinusoidal, and here again a great convenience is achieved since the various calculations can be made according to standard practice. The duration found to be most effective and most certainly harmless is from one-tenth to one-fifth of a second. With the shorter duration each hemisphere of the brain receives five discrete maximal stimuli, since it may be assumed that the effective parts of the wave train are the half-cycles which are negative with respect to each hemisphere. The alternating character of the stimulus and its short duration are extremely important, as they differ from the electrocutory shocks. Although stimulation with this type of current is both effective and convenient, it is by no means certain that it is the most efficient possible stimulus for the brain, and it will be interesting to discover whether a stimulus more like the discharges produced by the brain before and during a spontaneous fit would not be even more effective than the arbitrary commercial product.

The electrodes for the treatment are very large: those of Cerletti and Bini have an area of about 100 square cm. The authors have used a simpler design of about a quarter of this area applied over the anterior extremity of the frontal lobes. Even with this area of application the whole of the frontal lobes receives an adequate stimulus. The instantaneous effect of applying the current is twofold: first, a short sharp jerk of every part of the body indicating direct stimulation of the pre-central gyrus, and second, immediate loss of consciousness. These two facts together indicate the profound and widespread effect of the stimulus.

With regard to the convulsion itself, it resembles very closely the cardiazol fit or a rather brief spontaneous seizure. The total duration is remarkably constant at about 45 seconds; the tonic phase is shorter than in most spontaneous fits and clonic jactitation becomes evident about ten seconds from the onset.

From the typical character of the fit itself and from its occasionally prolonged latency one may imagine that the effect of the brief but intense and widespread stimulus is to set up in the cortex, or possibly at a lower lever, some process similar to that observed in the resting electro-encephalogram of idiopathic epileptics, a process which in favorable circumstances will throw the whole effector system into a state of rapidly alternating rest and maximal activity, that is a phenomenon which we recognize as an epileptic seizure.

Acute General Paresis. M. Herman, and M. P. Rosenblum.

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General paresis is commonly considered a chronic disease that begins insidiously and progresses rather slowly. That an acute onset with a rapid termination may occur has not been well recognized. Prompt diagnosis in these acute forms is important because of the serious prognosis without the early institution of treatment.

Some have recommended immediate institution of fever therapy, malaria or other type. Others have recommended for prompt action the use of a soluble preparation of mercury, such as the bichloride, succinimide, or red iodide injected intramuscularly daily or every other day in doses varying from 1/8 gr., to ½ gr.

Solomon and his co-workers have indicated that the preliminary use of tryparsamide injections greatly enhances the probabilities of therapeutic success in the treatment of general paresis by fever, and that the improvement of spinal fluid findings occurs more rapidly following fever if the patient has first been prepared by treatment with tryparsamide. This method appears to be readily applicable to an acute care. Whatever method is used, prompt institution of treatment is indicated in order to avoid a fatal termination.